Sunnyview Pre-Construction Monitoring Report

Prepared for:
The Harford County Department of Public Works

December 2006
Revised April 2007

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Environmental Assessment
Open End Contract No:
03-151

KCI Job Number:
010313111

KCI
TECHNOLOGIES

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1.0 INTRODUCTION

Harford County has recently requested the pre-construction monitoring of an unnamed tributary of Bynum Run, which is situated in the general vicinity of Sunnyview and Ring Factory Roads. Specifically, the project will extend from the tributary's confluence with Bynum Run near McPhail Road and terminate upstream at the Town of Bel Air corporate limits, in Harford County, Maryland (see Figure 1 – Site Vicinity Map).

This report presents the methods used to monitor the pre-construction conditions and sediment loads within the system, as well as the results, a discussion, and conclusions from the pre-construction monitoring effort. The year one data will serve as the baseline condition to which subsequent yearly monitoring events can be compared. Reports for the yearly monitoring events that will follow the Year One event will not repeat the introduction and methodologies sections, but instead will consist of supplements that include only the results, discussion and conclusions sections for those years, which can then be added to this monitoring report.

1.1 DESCRIPTION OF PRE-CONSTRUCTION EFFORTS

The 2,800 linear foot study was developed to compare pre-construction conditions to future post construction restoration efforts. The main purpose of the project was to track lateral channel movement, downstream aggradation, stream down cutting, and sediment transport. KCI has implemented a geomorphic monitoring program consisting of establishing benchmarks and cross-sections, surveying and analyzing cross-sections and thalweg profile, installing and monitoring bankpins, and evaluating sediment transport. In addition, biological sampling was conducted which included the collection and analysis of the macroinvertebrate community and a physical habitat assessment.

1.2 OVERVIEW OF MONITORING ACTIVITIES

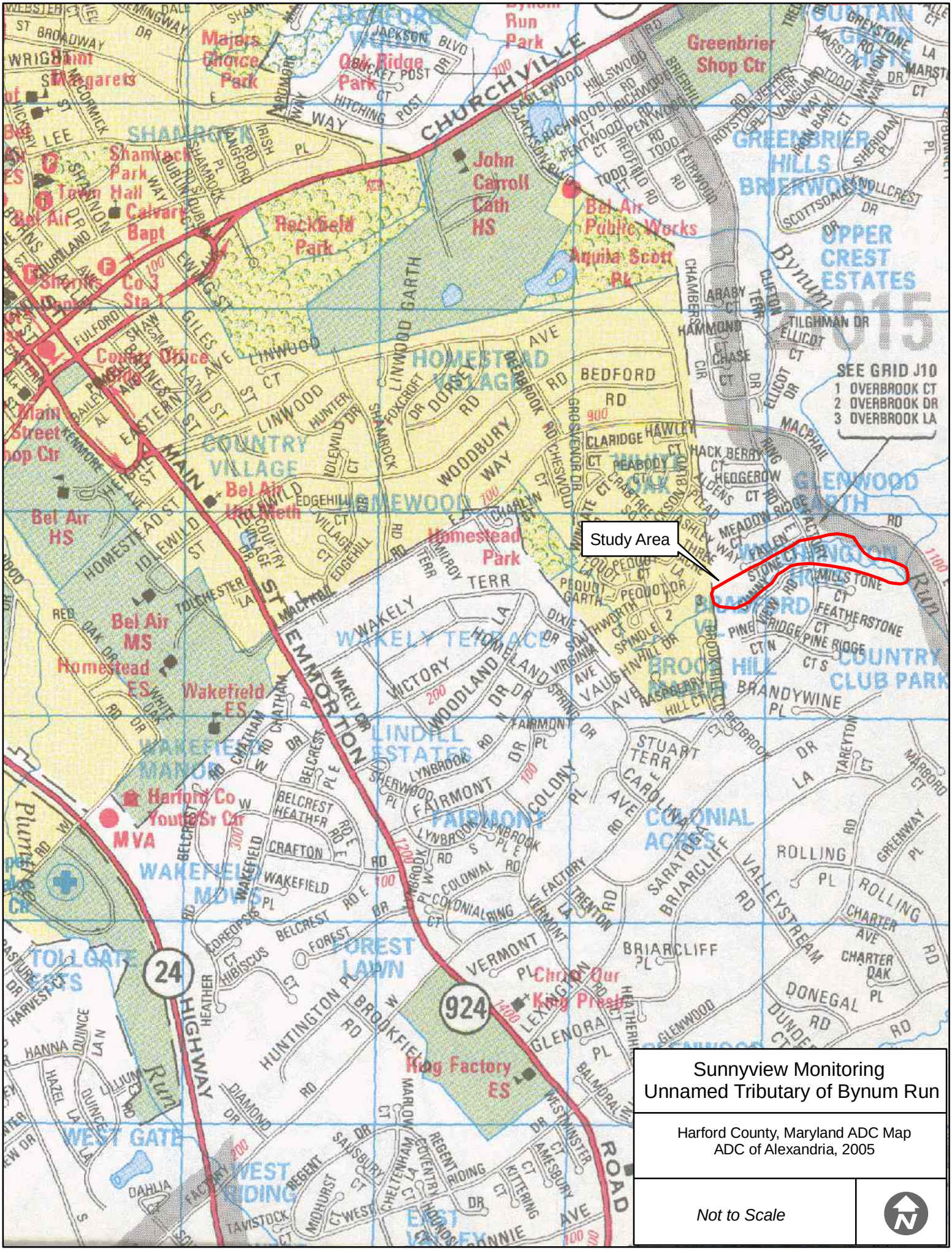
Monitoring protocols for the unnamed tributary site were developed in order to evaluate the existing conditions of channel geometry, sediment load and macroinvertebrate colonization. The monitoring program, as detailed briefly below and in greater detail in the methodologies section, is conducted on an annual basis, beginning in 2005.

Geomorphic monitoring is conducted in order to evaluate the bed and bank stability, channel profile and bed features, and bankfull event effects. Four monumented channel cross-sections were established during baseline monitoring at various critical locations along the tributary. It is anticipated that each section will be measured annually during subsequent monitoring years.

Macroinvertebrate sampling for the pre-construction assessments will involve three locations and will be photographically documented. Two of the three locations are within the unnamed tributary; one within the study site and the other upstream. The third sampling location will be off site and serve as a control to which the others stations can be compared.

1.3 GOALS AND OBJECTIVES

As detailed previously, the Sunnyview site is being monitored to establish baseline pre-construction conditions, which will be compared to geomorphic and biological data collected after the completion of restoration activities to evaluate the success of the project.


Study Area
SEE GRID J10
1 OVERBROOK CT
2 OVERBROOK DR
3 OVERBROOK LA
Sunnyview Monitoring
Unnamed Tributary of Bynum Run
Harford County, Maryland ADC Map
ADC of Alexandria, 2005
Not to Scale

2.0 METHODOLOGIES

2.1 FLUVIAL GEOMORPHIC ASSESSMENT MATERIALS AND METHODS

The fluvial geomorphic assessment is conducted to quantify basic stream characteristics including bed and bank stability. Cross-sectional and longitudinal profile surveys were completed within the study reach to establish baseline conditions and will subsequently be compared to the changes in channel geometry and slope that may occur over ensuing annual monitoring events. Bank and bed pins are monitored to determine rates of potential bank and channel bed erosion or aggradation. Detailed methods are described below.

2.1.1 Longitudinal Profile and Cross-sectional Surveys

An installation and survey of three (3) concrete benchmarks was completed during the Year One monitoring effort to tie the existing conditions cross section and profile survey data to the respective elevations of the project site. Stream restoration specialists surveyed a longitudinal profile of the reach during the baseline monitoring event. The profile is established along the thalweg thread and includes a survey of breakpoints in and between bed features and delineation of riffles, runs, pools and glides. A survey of the bankfull elevation (where discernable) and water surface was also performed. The plotted longitudinal profile serves as the baseline for comparison during subsequent years and is used to track changes that occur in the bed sequences. The slope was determined by subtracting the elevation at the top of a riffle at the downstream extent of the project from the elevation at the top of a riffle at the upstream end of the project, then dividing this number by the total length of the channel between these two points, as measured along the thalweg of the stream. The longitudinal profile is field surveyed annually using a laser level, calibrated stadia rod, and measuring tape. The longitudinal survey began at the up stream most point of the monitored reach.

In order to establish locations where fluvial geomorphic characteristics of the channel could be measured and compared from one year to the next to assess bed and bank stability, permanent cross-sections were established at six (6) locations along the channel; three within riffles and three within pools. Each cross-section was monumented on both sides of the channel. In discrete areas, the monument consists of a carriage bolt set into concrete in a PVC pipe cast. In other areas that are frequented by landowners, the monument consists of a single piece of rebar driven flush with the ground surface. The monument locations and elevations were surveyed and used to establish correct elevations to the longitudinal and cross sectional data. Cross-sections are field surveyed annually at each of the following stations using a laser level, calibrated stadia rod, and measuring tape. Cross-sections stations are measured from upstream to downstream, see Figure 2 for respective locations.

Section 1 - Station 1+46
Section 2 - Station 7+78
Section 3 - Station 12+23
Section 4 - Station 12+70
Section 5 - Station 24+24
Section 6 - Station 26+60

Surveyed cross-sections are plotted and data collected during subsequent monitoring events will be overlaid and compared to the baseline condition cross-sectional measurements. The focus of these evaluations is on hydraulic geometry including bankfull width, mean depth, and width/depth ratios and the overall bank stability.

For the purpose of this report, bankfull elevations were selected based upon topographical breaks in the constructed geometry that appear to represent bankfull features. Because bankfull indicators were not readily evident at all locations due to the extensive bank instability, best professional judgment was used to establish potential bankfull elevations based on a cross sectional flow analysis. For future monitoring events, these elevations will be utilized as the set bankfull elevations at each section to generate hydraulic geometry values that are directly comparable between each monitoring effort.

2.1.2 General Bank Stability (Bank Pins and Bed Pins)

To monitor channel adjustments, KCI installed bank and bed (toe) pins at three of the six permanent cross-section locations. Two-foot pins consisting of rebar were horizontally hammered into the top and toe of the vertical bank face until approximately one-inch was exposed above the surface. At station 7+78 three pins were installed into the bank due to the height of the bank and at station 12+70 only one bank pin was installed in the vertical face. Much of the vertical bank was covered with an exposed tree root, which precluded the installation of an additional pin. Channel pins were installed vertically into the bed of the stream. Following installation, the offsets for each bank and channel pin were measured, beginning from the left monument (looking downstream/up-station along the survey baseline) at each of these cross-sections. Three sets were installed; two within riffles and one within a pool area. Locations and offsets for the pins are listed below. Pins installed horizontally into the vertical bank were measured from the top of the channel pin up to their location, channel pins were measured horizontally from the left bank cross section pin, "H" represents horizontal and "V" represents vertical offsets:

Station 7+78 -Riffle - Right Bank

Offsets	0+02.7 (V)	Bank Pin (Above Bankfull)
	0+00.8 (V)	Bank Pin
	0+00.1 (V)	Toe Pin (Below Bankfull)
	0+38.8 (H)	Channel Pin

Station 12+70 -Pool - Left Bank

Offsets	0+01.4 (V)	Bank Pin
	0+07.7 (H)	Channel Pin

Station 26+61 – Pool – Left Bank

Offsets	0+01.8 (V)	Bank Pin
	0+00.4 (V)	Bank Pin
	0+08.0 (H)	Channel Pin

The exposed length of each pin was measured during Year One monitoring efforts and the pins are surveyed annually to assess bed and bank erosion. Channel pin exposure is measured in place of scour chains. This will allow measurement of total scour or deposition at the cross section.

2.2 BANKFULL EVENT INSPECTION

A cursory visual assessment will take place following a bankfull or significant storm event. The inspection will take place within one week, or upon water levels returning to safe working conditions and information gathered/observations will be compared to previously collected data and photographs. If there proved to be any substantial changes to the system, stream specialists will re-survey any cross-sections they deem necessary to verify excessive scour, undercutting, erosion, or other type of failure. Photographs and notes will be recorded as to the degree and extent of the problem.

2.3 SEDIMENT AND DISCHARGE ANALYSIS

Sediment analysis was conducted using sediment traps during storm events and the associated discharge during the events was also recorded. Sediment traps were installed down stream of the gauge location and collected after five storm events. Location of both the gauge and sediments buckets can be seen on Figure 2. In one storm event the sediment traps filled before the end of the storm, providing incomplete data on the material transported. This event was considered a false start and was not used in generating any sediment discharge relationships. Sediment samples were analyzed four times from April- June 2006 for this report

2.3.1 Discharge Estimates

KCI established a depth gauging station to estimate discharge during storm events. The depth logger used was by Onset, HOBO® U-series depth loggers. The depth logger recorded the total pressure and was calibrated to depth of water using temperature. All calibrations were done with the Hoboware™ Software as provided by Onset with the depth loggers. The cross section at the gauge was surveyed and input to FlowMaster, by Heasted Methods Inc. (2004) to create the rating curve for discharge estimates and The Reference Reach Spreadsheet (Mecklenburg 2006) for cross section analysis. Additional reach attributes were taken from the geomorphic survey to complete the rating curve. Manning's n was estimated visually (n= 0.04) (Strum 2001) and validated using the D84 method with correction factors (n= 0.0434) (Strum 2001).

2.3.2 Sediment Collection

Sediment collection was done by sampling across the entire stream width. A total of 24 buckets were installed in two rows, with the second row centered on the edges of the first row. This created a locked in pattern that ensured coverage across the entire channel. The five-gallon buckets were lined with 50lb feed sacks and secured with rubber bands and bricks. The bottoms of the buckets were removed to allow burial up to the lip, the excess feed sack was folded over the bucket and secured. The traps were set prior to a forecasted precipitation event. Every other sack from the 24 buckets was removed (alternating starting bucket for each storm sampling) after storms when flow returned to normal or safe removal conditions. The bags were allowed to drain and then sorted collectively through dry sieve analysis. Along with the sieve analysis the largest particle was measured and weighed.

2.4 BIOLOGICAL MONITORING

KCI in conjunction with Harford County DPW established stream monitoring stations on an Unnamed Tributary to Bynum Run at Sunnyview Road at two locations in the Fall of 2005. The monitoring stations are being used for the collection of baseline data for the assessment of the proposed restoration activities on this tributary. The baseline conditions stream monitoring took place on November 4, 2005.

2.4.1 Monitoring Stations

The Pre-Construction monitoring program performed on the unnamed tributary to Bynum Run at Sunnyview Road by KCI Technologies, Inc. (KCI) involved sampling and analysis of the macroinvertebrate community, assessment of the physical habitat, and photo-documentation of conditions at three monitoring stations (Figure 2). Monitoring stations include:

- Station 1 – Upstream Reach: Located 200 meters upstream of the proposed restoration reach. The station includes a 75-meter reach. The station is characterized by an unconsolidated gravel and sand substrate. Riparian buffer along the left bank (facing downstream) is made up of a 15 meter strip of forested riparian with a new housing development behind that. The right bank includes full forested riparian zone.

- Station 2 – Restoration Reach: the proposed restoration reach includes a 75-meter reach running parallel to Sunnyview Road starting approximately 150 meters from the Ring Factory Road culvert. Station 2 is characterized by a gravel and cobble substrate with some clay. Sunnyview Road housing properties lie adjacent to the entire length of the sampling reach leaving inadequate riparian buffer along the right bank (facing downstream). The riparian buffer along the left bank is forested for the entire length of the sampling reach.

- Station 3 - Reference Reach: Located on Carsins Run south east of Walnut Road of MD 22. The monitoring station includes a 75-meter reach. The reach is composed primarily of small pool and riffle sequences with little pool habitat and small riffles with large cobble boulder substrate.

2.4.2 Methods

Benthic Macroinvertebrate Sampling and Analysis

Benthic macroinvertebrate collection follows procedures described in the Maryland Biological Stream Survey Sampling Manual (Kazyak, 2001). Monitoring sites cover a 75-meter reach and benthic macroinvertebrate sampling is usually conducted during the spring season. However, because KCI received a later notice to proceed for this job site, the earliest samples could be collected was in November. MBSS methodologies utilize systematic field collections of the benthic macroinvertebrate community of a stream. The multi-habitat D-frame net approach is used to sample a range of the most productive habitat types within the reach. In this sampling approach, a total of twenty samples or jabs, are distributed among all available habitats within the stream system and combined in a composite sample. Potential habitats include submerged vegetation, overhanging bank vegetation, leaf packs, mats of organic matter, stream bed substrate, submerged materials (i.e., logs, stumps, snags, dead branches, and other debris) and rocks.

Samples are then processed and subsampled according to methods described in the MBSS Laboratory Methods for Benthic Macroinvertebrate Processing and Taxonomy (Boward and Friedman, 2000). Subsampling is conducted to standardize the sample size and reduce variation caused by samples of varying size. In this method the sample is spread evenly across a gridded tray and each grid is picked clean of organisms until a count of 120 is reached. The 120 target is used to allow for specimens that are missing parts or are not a late enough instar to properly identify. Individuals are identified down to the genus level.

MBSS has recently updated their method for analyzing benthic macroinvertebrate data. Data was analyzed using methods developed by MBSS as outlined in the *New Biological Indicators to Better Assess the Condition of Maryland Streams* (Southerland et al., 2005).

Benthic Index of Biotic Integrity

The BIBI approach involves statistical analysis using metrics that have a predictable response to water quality and/or habitat impairment. The selected metrics fall into five major groups including taxa richness, taxa composition, tolerance to perturbation, trophic classification and taxa habit. Raw values from each metric are given a score of 1, 3 or 5 based on ranges of values developed for each metric. The results are combined into a scaled BIBI score from 1.0 to 5.0 and a narrative rating is applied. Three sets of metric calculations have been developed for Maryland streams based on broad physiographic regions. These include the coastal plain, piedmont and combined highlands regions as demarcated by the Fall Line.

The unnamed tributary to Bynum Run at Sunnyview Road site is located in the general vicinity of Sunnyview and Ring Factory Roads and has characteristics of piedmont streams, therefore the piedmont approach was selected for the analysis. The following metrics were used for the BIBI analysis.

Non-Coastal Plain Metrics

Total Number of Taxa – Equals the richness of the community in terms of the total number of genera at the genus level or higher. A large variety of genera typically indicate better overall water quality, habitat diversity and/or suitability, and community health.

Number of EPT Taxa – Equals the richness of genera within the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). EPT taxa are generally considered pollution sensitive, thus higher levels of EPT taxa would be indicative of higher water quality.

Number of Ephemeroptera taxa – Equals the total number Ephemeroptera Taxa in the sample. Ephemeroptera are generally considered pollution sensitive, thus communities dominated by Ephemeroptera usually indicate lower disturbances in water quality.

Percent of Intolerant Urban Taxa – Equals the percent of individuals in the sample that are considered intolerant to urbanization (tolerance values 0 – 3). The percent of intolerant urban taxa is expected to decrease with decreasing water quality.

Percent Chironomidae Taxa- Equals the percent of individuals in the sample that are in the Chironomidae family. An increase in the percent of Chironomidae is generally an indicator of decreasing water quality.

Percent Clinger Taxa – Equals the percentage of the total number of individuals who are adapted to attaching to surfaces in stream riffles. Higher percentages of clingers are representative of a decrease in stressors and higher water quality.

Information on trophic or functional feeding group and habit were based heavily on information compiled by DNR and from Merritt and Cummins (1996). Scoring criteria are shown below in Table 2-1 for the coastal plain region. The raw metric value ranges are given with the corresponding score of 1, 3 or 5. Table 2-2 gives the BIBI ranges and ratings.

Table 2-1 Biological Condition Scoring for the Piedmont

Metric	Score		
	5	3	1
Total Number of Taxa	≥25	15-24	<15
Number of EPT Taxa	≥11	5-10	<5
Number of Ephemeroptera Taxa	≥4.0	2-3	<2
Percent of Intolerant Urban Taxa	≥51.0	12-50	<12
Percent Chironomidae Taxa	≤4.6	4.7-63	>63
Percent Clinger Taxa	≥74	31-73	<31

Table 2-2 BIBI Scores

BIBI Score	Narrative Rating
4.0 – 5.0	Good
3.0 – 3.9	Fair
2.0 – 2.9	Poor
1.0 – 1.9	Very Poor

Physical Habitat Assessment

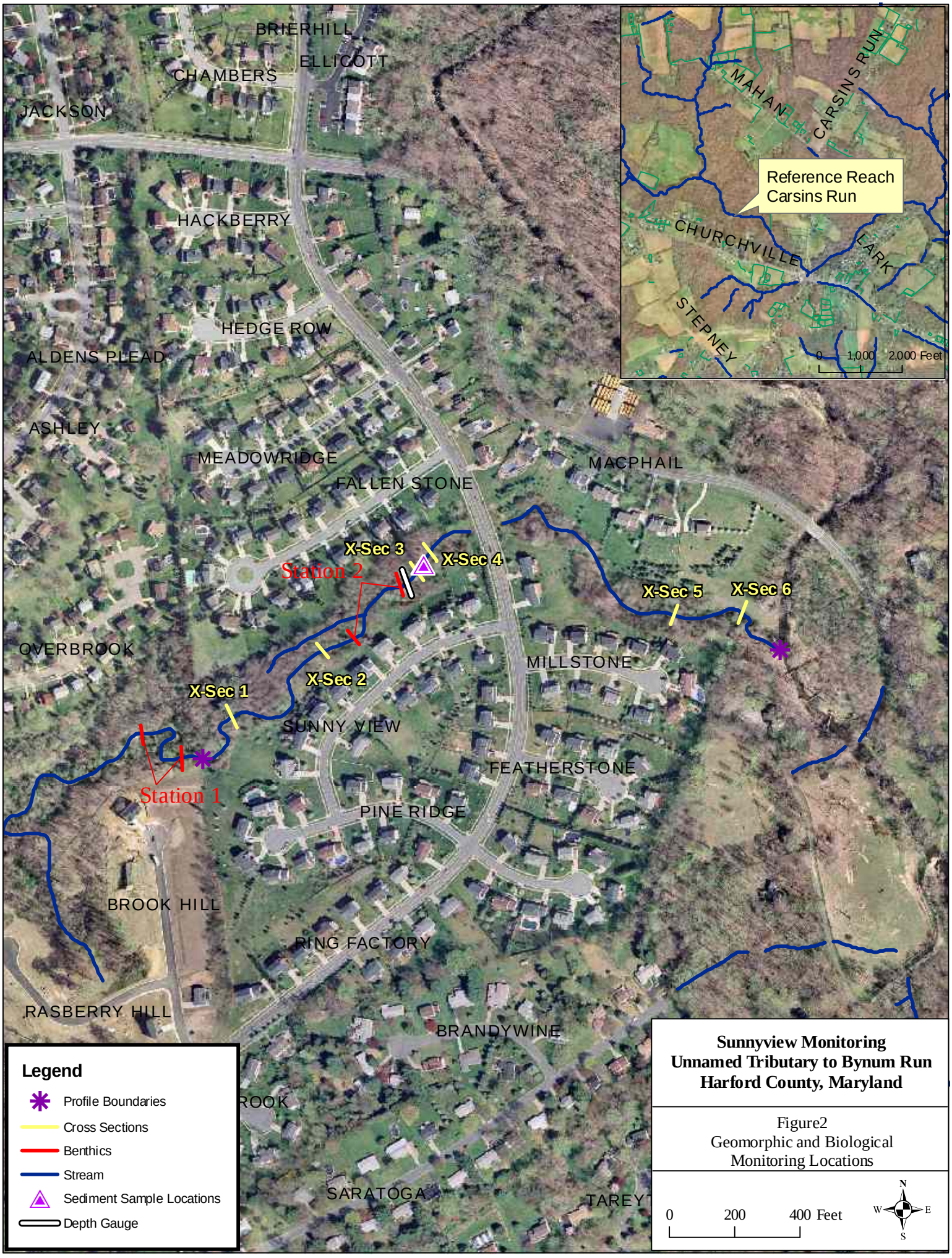
Habitat assessments were completed at all of the monitoring sites to evaluate the reach's ability to support aquatic life. DNR's Physical Habitat Index (PHI) (Paul et. al, 2003) was used for the 3 sites assessed in the Fall of 2005.

The PHI was completed for each site. The PHI incorporates the results of a series of habitat parameters selected for Coastal Plain and Non-Coastal Plain streams. While all parameters were rated during the field assessment, the Non-Coastal Plain parameters were used to develop the PHI score for the unnamed tributary to Bynum Run. These eight parameters were found to have the most discriminatory power for Piedmont streams.

Embeddedness
Remoteness
Epibenthic Substrate(EPI)
Instream Woody Debris and Rootwad
Riffle Quality
Tree Shading
Instream Habitat
Bank Stability

Each station was given a raw score (0-20) (Table 3-8), and a calculated, scaled PHI score (0-100), and ranking according to the following ranges.

Minimally Degraded – 81.0-100.0
Degraded – 51.0-65.9
Partially Degraded – 66.0-80.9
Severely Degraded – 0.0-50.9


BRIERHILL
ELLICOTT
CHAMBERS
JACKSON
HACKBERRY
HEDGE ROW
ALDENS PLEAD
ASHLEY
MEADOWRIDGE
FALLEN STONE
MACPHAIL
OVERBROOK
MILLSTONE
SUNNY VIEW
FEATHERSTONE
PINE RIDGE
BROOK HILL
RING FACTORY
RASBERRY HILL
BRANDYWINE
SARATOGA
TAREY
X-Sec 1
X-Sec 2
X-Sec 3
X-Sec 4
X-Sec 5
X-Sec 6
Station 1
Station 2
MAHAN
CARSINS RUN
Reference Reach
Carsins Run
CHURCHVILLE
LARK
STEPNEY
0 1,000 2,000 Feet
Legend
Profile Boundaries
Cross Sections
Benthics
Stream
Sediment Sample Locations
Depth Gauge
Sunnyview Monitoring
Unnamed Tributary to Bynum Run
Harford County, Maryland
Figure2
Geomorphic and Biological
Monitoring Locations
0 200 400 Feet
N
W
E
S

3.0 MONITORING YEAR 1: RESULTS AND DISCUSSION

3.1 FLUVIAL GEOMORPHIC ASSESSMENT

3.1.1 Longitudinal Profile, and Cross-sectional Surveys

The baseline longitudinal survey of the project study area was completed by KCI in November 2005. While performing the longitudinal profile, bed features such as, riffles, pools, runs, glides, bankfull indicators (where readily discernable) and water surface were noted to sufficiently assess pre-construction conditions. The longitudinal profile data was also analyzed to estimate the slope of the channel. Based on the 2005 monitoring data, the average channel slope is estimated at 0.98 percent. Upstream of Sunnyview Rd (station 14+69) the average slope is 0.95 percent while downstream of the road (station 15+60) the slope is approximately 1.1 percent. The bridge is protected from erosion with rip rap for 100-ft both upstream and downstream of the bridge. This data will be compared to subsequent annual monitoring data to track potential changes in the overall channel slope. Refer to Appendix A for photographs depicting the overall site conditions. In addition, the surveyed profile during these annual events will be plotted, overlain and compared to the baseline condition profile (Appendix B) in order to assess changes occurring in the bed structure.

Cross-sectional surveys were analyzed at each of the six permanent monitoring locations to determine bankfull width, mean depth, the width/depth ratio, and overall cross-sectional area during baseline conditions. As discussed previously, bankfull indicators were not readily evident at all locations due to the extensive bank instability. Therefore, best professional judgment was used to establish potential bankfull elevations for areas that did not have adequate field indicators. Bankfull discharge was estimated at each section based the judgment used to approximate bankfull elevations. This same elevation and corresponding bankfull discharge will be utilized in future analyses to track changes in the cross sectional dimensions listed below. Results of the cross-sectional measurements are included in Table 3-1 and graphical depictions of each section are presented in Appendix C.

Table 3-1 Results of Cross-sectional Survey Analysis

Date Performed	Bankfull Width (ft)	Mean Depth (ft)	Width/ Depth Ratio	Cross-sectional Area (ft^2)	Estimated Bankfull Discharge (ft^3/s)
Station 1+46 Pool					
November 4, 2005	14.9	0.9	12.9	10.0	168.1
Station 7+78 Riffle					
November 4, 2005	20.0	1.0	17.8	18.3	125.9
Station 12+23 Riffle					
November 4, 2005	23.2	0.9	22.3	16.8	189.2
Station 12+70 Pool					
November 4, 2005	15.0	1.2	11.9	17.5	165.3
Station 24+24 Riffle					
November 4, 2005	20.9	0.7	24.7	12.7	163.1
Station 26+61 Pool					
November 4, 2005	21.0	1.1	19.0	21.1	155.2

Future monitoring events will compare the duplicated cross-sectional data and will be overlain with data from past monitoring events to further track any noticeable changes (i.e. bank erosion, deposition,

slumpage). The cross-sectional data will also be used to compare bankfull width, mean depth, the width/depth ratio, and overall cross-sectional area during baseline conditions.

3.1.2 General Bank and Bed Stability

During the baseline condition monitoring, bed and bank pins were installed and the exposed length of each pin was measured. At Station 12+70, the bank is eroding around an exposed tree root, which prohibited installation of more than one bank pin. Scour chains were not installed at the site. In lieu of scour chains, the channel pin will be monitored for total bed erosion or deposition.

Table 3-2 Pin Locations and Measurements - Station 7+78 Riffle

Location Along Section	Bank/ Toe/Channel Pin	Level of Exposure/Deposition (feet)
		11/03/05
0+02.7(V)	Bank – Above Bankfull	-0.08
0+0.82(V)	Bank – Below Bankfull	-0.15
0+0.11 (V)	Toe Pin	-0.13
0+12.5 (H)	Channel	-0.20

Table 3-3 Pin Locations and Measurements - Station 12+70 Pool

Location Along Section	Bank/ Channel Pin	Level of Exposure/Deposition (feet)
		11/03/05
0+1.44 (V)	Bank Pin	-0.38
0+7.7 (H)	Channel	-0.73

Table 3-4 Pin Locations and Measurements - Station 26+61 Riffle

Location Along Section	Bank/ Toe/Channel Pin	Level of Exposure/Deposition (feet)
		11/03/05
0+1.33 (V)	Bank	-0.07
0+01.03 (V)	Toe	-0.93
0+8.0 (H)	Channel	-0.38

"H" represents a horizontal offset (pin is located in channel or top of bank)
"V" represents a vertical offset (pin is located in the bank)

Subsequent monitoring data will be compared to these baseline conditions to evaluate erosion and depositional trends associated with the study reach. Negative values for the measurements indicate the length of pin exposed, while positive values indicate the amount of deposition on top of the pin.

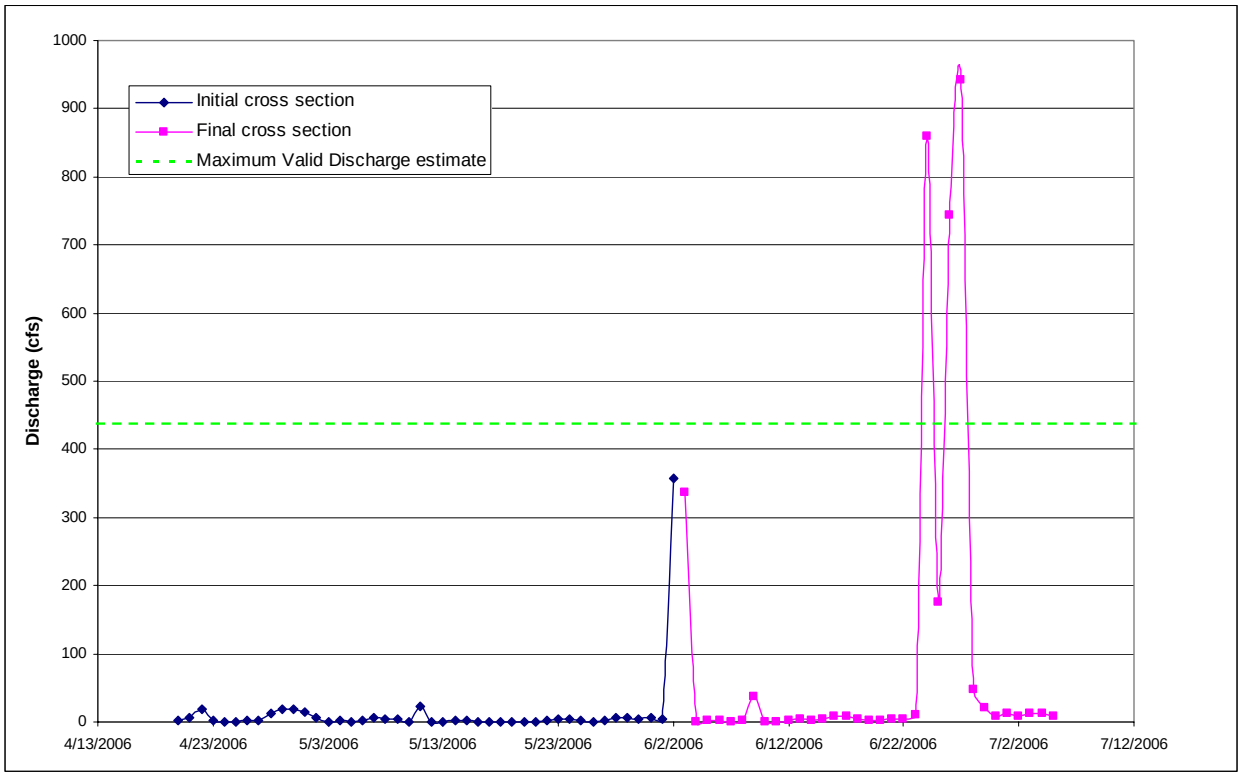
3.2 BANKFULL EVENT INSPECTIONS

No bankfull events were sample during the 2005 data collection period. General channel condition was assessed during sediment bag collection. During each collection it was determined a full survey of the banks was unnecessary.

3.3 SEDIMENT DISCHARGE ANALYSIS

The daily maximum discharge estimated from the data loggers is shown in Figure 3. During the course of the sampling events a portion of the gauged cross section was buried while another was scoured. This change was verified with an additional survey of the cross section. It is estimated that the change in the cross section did not occur until the June 3, 2006 storm. The discharge for storms prior to June 3rd were estimated using the initial cross sectional area while storms occurring after this date us the final cross sectional area. The rating curve and cross sectional data at the gauge can be found in Appendix D.

Figure 3- Daily Maximum Estimated Discharge at Sunnyview for Year 1 Monitoring



Sediment samples were analyzed four times from April- June 2006 for this 2005 report. The particle size distribution for the collected samples is shown in Figure 4 below. The full particle size report from each storm is included in Appendix D. Results for the estimated discharge and largest particle collected per sampling storm event are shown in Table 3.6. Average daily flow at the site was below 1.0 cfs. Storm events associated with discharge greater than 2.72 cfs showed a dramatic increase in the largest particle size collected. This may correspond to the threshold between suspended load and bed load movement.

Figure 4- Particle Size Distribution from Sediment Traps at Sunnyview for Year 1 Monitoring

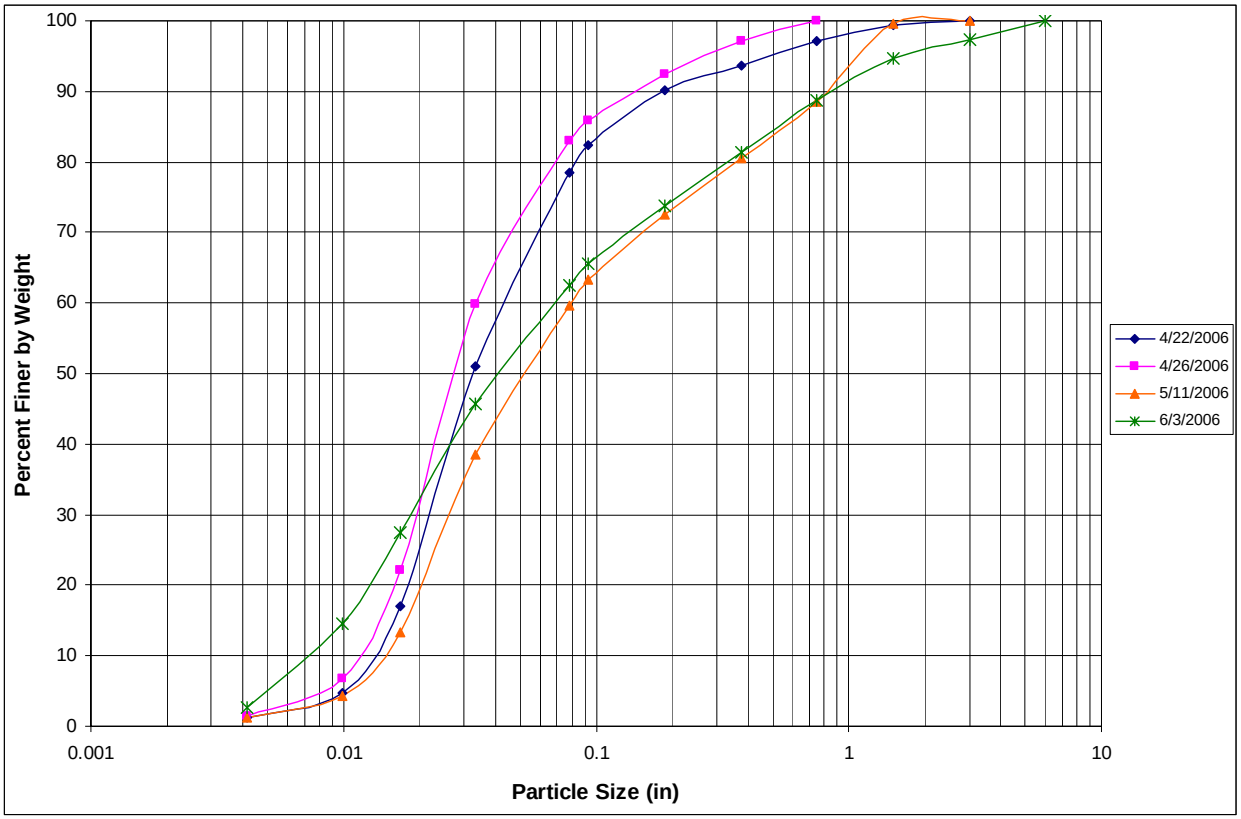


Table 3-6 Sediment Sample Weights' per Storm Sampled

Date of Peak Discharge After a Storm	Estimated Discharge (cfs)	Largest Particle's Wt. (g)	Total Sample Wt. (lb)
April 22, 2006	18.4	200	75.9
April 26, 2006	2.72	4.10	3.57
May 11, 2006	23.1	351	182
June 3, 2006	336	752	62.2

The largest sieve size is represented by only one particle, the largest particle, for all but the April 26, 2006 storm. This storm also contains the smallest percent of gravel (shown as part of particle analysis report in Appendix D), which indicates the highest percent of fines were mobilized during this storm event. Larger storm events mobilized much greater particle sizes which are supported by greater percents of gravel being collected.

The largest storm discharge produced a smaller total sample weight than the second and third largest storms. However the largest particle was collected during the largest storm discharge. The sampling technique used in this study relies on particles traveling across the bed and dropping into the buckets or sediments suspended in the water column settling into the buckets. The settling may only occur at specific velocity and discharge due to scour occurring in the buckets at particular velocity and discharge. This may have been the reason for less sediment collected during the largest storm. The scour associated with that discharge removed much of the potential catch. Larger particles are mobilized at greater discharge due to increased shear stress on the particles, until a bankfull elevation is reach. At this time, the stream's shear stress peaks as the water flows onto the floodplain area. At the gauged site the average bankfull discharge is approximately 193 cfs. The discharge during the June 3, 2006 storm was above this

bankfull condition which may have reduced the amount of particles collected due to scour, yet was strong enough to mobilize a larger particle as this storm approached the bankfull condition. The storms on April 22, 2006, April 26, 2006, and May 11, 2006 were below bankfull condition and may have had enough shear stress to mobilized a large number of particles, yet not reaching a high enough shear stress to move as large of particle collected during the June 3, 2006 storm or to scour out sediments that had previously settled into the buckets. The bankfull elevation is also associated with overland flow at the gauged site. Overland flow could have provided more locations of sediment storage outside the active channel which would contribute to less sediment collect in the sediment traps. The data collected during year 1 preconstruction monitoring can be used to generally characterize the sediment discharge. Continued monitoring will produce a sediment rating curve that can be used to predict sediment transport relative to season fluctuations in stream flow. Data can also be stratified to evaluate the seasonality of sediment transport events.

3.4 BIOLOGICAL MONITORING RESULTS

3.4.1 Benthic Macroinvertebrate Results

Benthic macroinvertebrate sampling data and BIBI scores are presented in Table 3-7 below. Complete taxa lists and metric evaluation data are included in Appendix E.

Both Station 1 and Station 2 were classified as poor reaches with overall scores of 2.0 and 2.3, respectively. The Reference Reach has been classified as good with a score of 4.0. For this initial monitoring event sampling was conducted on November 4, 2005 outside of the standard spring sampling season, which may have contributed to the low numbers of individuals in the sample.

Table 3-7 Summary Benthic Macroinvertebrate Results

	Station 1	Station 2	Reference
Raw Scores			
Total Number of taxa	21	24	29
Number of EPT taxa	4	5	10
Number of Ephemeroptera Taxa	0	0	4
Percent Intolerant Urban Taxa	8	9	51
Percent Chironomidae Taxa	30	5	15
Percent Clinger Taxa	33	60	70
BIBI Scores			
Total Number of taxa	3	3	5
Number of EPT taxa	1	3	3
Number of Ephemeroptera Taxa	1	1	5
Percent Intolerant Urban Taxa	1	1	5
Percent Chironomidae Taxa	3	3	3
Percent Clinger Taxa	3	3	3
BIBI Score	***2.0***	***2.3***	***4.0***
Narrative Rating	***P***	***P***	***G***

The upstream reach (Station 1) received the lowest overall BIBI score of the three sampling sites, falling at the low end of the 'poor' range. This station had the highest percentage of Chironomidae and the lowest percentage of intolerant urban and clinger taxa. The sample was dominated by tolerant individuals

of the Trichoptera and Diptera orders. There were only 61 individuals collected in the entire sample. Only 5 of the 61 individuals sampled were considered intolerant to urban land uses.

A total of 24 taxa were identified at Station 2, the proposed restoration reach. This reach also received a 'poor' overall BIBI rating. This sample was dominated by individuals of the Odonata and Trichoptera orders. This station received similar BIBI metric scores to those at Station 1, with the exception of the 'Number of EPT Taxa' metric, for which it received a slightly higher score. The number of Ephemeroptera taxa and the number of intolerant urban taxa metrics both received the lowest possible BIBI score of 1. As with Station 1, the 120-organism target was not met for this sample. The entire sample yielded only 77 individuals.

The Reference Reach on Carsins Run south east of Walnut Road had the highest taxa richness with 29 taxa identified. Eleven of these were EPT taxa. Fifty-one percent of the sample was comprised of individuals considered intolerant to urban land uses. The reference reach is the only one of the three sampled with Ephemeroptera taxa present, receiving the highest possible score (5) for the 'number of Ephemeroptera taxa' metric. Subsampling for the Reference Reach required 15 grids to reach the target organism count. The reference site received an overall BIBI rating of 'good', the highest rating of the three sites.

3.4.2 Physical Habitat Assessment

A summary of the Physical Habitat data is presented in Table 3-8.

Station 1, the upstream reach, resulted in the lowest PHI overall, due to the poor substrate habitat available for macroinvertebrates and banks that are moderately eroded despite the presence of a fairly well established riparian zone on the left bank. The presence of the newer housing development reduces the remoteness. The station is characterized by an unconsolidated gravel and cobble substrate with a section of clay substrate. Riparian buffer along the left bank (facing downstream) is adequate throughout the sampling reach. The right bank has a small forested buffer in the upper reach with residential properties occupying the downstream portion of the sampling reach. Overall this station had a PHI score of 50.90, with a narrative rating of Severely Degraded.

Station 2, the proposed restoration reach, also scored fairly low, receiving an overall score of 57.33 with a narrative rating of Degraded. This site had the lowest remoteness score due to the residential properties mowing right up to the stream banks, leaving little to no riparian zone along the entire reach on the right side (looking downstream). This reach is also highly entrenched and severely eroded. The large number of woody debris and rootwads present contribute to the higher instream habitat score.

The Reference Reach, receiving a PHI score 76.01 and a rating of Partially Degraded, was the highest ranked reach out of the three. It scored the highest in all categories except for instream woody debris. This reference reach was chosen based on its in-stream condition similarities to Stations 1 and 2. The reach is composed primarily of pool and run sequences with stable pool habitat and small riffles consisting of gravel cobble substrate.

Table 3-8 Summary of Physical Habitat Index Results

Site	Remoteness	Percent Shading	Epibenthic Substrate	Instream Habitat	Instream Woody Debris	Bank Stability	PHI	Narrative Rating
Station 1	5	40	10	8	4	5	50.90	Severely Degraded
Station 2	4	60	10	13	8	5	57.33	Degraded
Reference Reach	15	65	12	15	4	10	76.01	Partially Degraded

4.0 CONCLUSION

The Harford County Department of Public Works, Water Resources Engineering Division requested KCI to perform stream monitoring to assist with the documentation of existing physical and biological conditions within an 2,800-foot reach of an unnamed tributary to Bynum Run at Sunnyview Road.

In general, the banks appear to be high and are eroding in several locations. These areas will be assessed and evaluated for change over the continued monitoring years. In addition, a heavy sediment load indicates there is substantial erosion throughout the monitoring reach. Conditions upstream of Sunnyview road appear more stable due to a lower slope and better access to the floodplain as evidenced by multiple split channels and overland flow locations noted in the longitudinal profile notes and descriptions. The riprap noted in the longitudinal profile near the bridge appears to be protecting the upstream area by serving as a grade control.

Based on the slight change in the gauged cross section over the last year it is recommended that the gauge be relocated further up stream at a stable cross section. After the storm on June 3, 2006 there was an approximate 6-in drop from the downstream face of the sediment buckets to the channel bed. In addition, the outer meander bend was beginning to erode further which was also beginning to undermine the downstream face of the sediment sampling set up. Storms that were not sampled but estimated at over 1000 cfs (though estimates over 400 cfs are outside the rating curve's confidence limits) washed away several of the sampling buckets. Based on these results it is also recommended that the sediment traps are re-set downstream from the year one monitoring location. Additional data collection through pebble counts may also help distinguish suspended load from bed load in the sieve analysis and help determine if the overall streambed is changing in coarseness. Continued gauge and sediment analysis will also provide insight for the seasonality and quantity of sediment transport at Sunnyview.

Baseline macroinvertebrate condition sampling at the unnamed tributary to Bynum Run at Sunnyview indicates poor quality. Low benthic macroinvertebrate scores received by Station 1 and Station 2 are likely due to reduced habitat availability. Overall, there is a loss of sensitive taxa at Stations 1 and 2. The results of the physical habitat assessments indicate fairly low habitat quality at Stations 1 and 2. The baseline conditions presented here will be compared to conditions and data collected in the post-construction phase to assess the impact of the restoration on the water quality and biotic community in the unnamed tributary.

Geomorphic and biological results described previously will be utilized as baseline data for comparison purposes for both subsequent pre-construction monitoring and ultimately for post-construction evaluation.

5.0 REFERENCES

ADC of Alexandria. Harford County, Maryland ADC Map, 2005.

Boward, D. and E. Friedman. 2000. Maryland Biological Stream Survey Laboratory Methods for Benthic Macroinvertebrate Processing and Taxonomy. Maryland Department of Natural Resources Monitoring and Non-Tidal Assessment Division. Annapolis, MD. CBWP-MANTA-EA-00-6.

Heasted Methods Inc. 2004. FlowMaster V7.

Kazyak, P.F. 2001 Maryland Biological Stream Survey Sampling Manual. Maryland Department of Natural Resources Monitoring and Non-Tidal Assessment Division. Annapolis, MD.

Leopold, L. B., M.G. Wolman and J.P. Miller. 1964. Fluvial Processes in Geomorphology. Freeman, San Francisco, CA.

Mecklenburg, D. 2006. The Reference Reach Spreadsheet- For Channel Survey Data Management. V 4.1L. Ohio Department of Natural Resources.

Merritt, R.W. and Cummins, K.W. 1996 An Introduction to the Aquatic Insects of North America, 3rd edition, Kendall / Hunt Publishing Company.

Paul, M.J., J.B. Stribling, R.J Klauda, P.F. Kazyak, M.T. Southerland and N.E. Roth. 2003. A Physical Habitat Index for Freshwater Wadeable Streams in Maryland, Final Report. Maryland Department of Natural Resources. Monitoring and Non-Tidal Assessment Division. CBWP-MANTA-EA-03-4.

Southerland, M.T., G.M. Rogers, M.J. Kline, R.P. Morgan, D.M. Boward, P.F. Kazyak, R.J. Klauda, S.A. Stranko. 2005. New Biological Indicators to Better Assess the Condition of Maryland Streams. DNR-12-0305-0100. Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division. Annapolis, MD.

Strum, T.W. 2001. Open Channel Hydraulics, 1st ed. McGraw-Hill. 493p.

APPENDIX A

SITE PHOTOGRAPHS

Photo 1 Facing up stream at top of study area

Photo 2 Facing down stream at top of study area

Photo 3 Facing up stream at cross section 1

Photo 4 Left bank of cross section 1 (facing down stream)

Photo 5 Right bank of cross section 1

Photo 6 Facing down stream of cross section 1

Photo 7 Facing up stream of blockage at station 2+35

Photo 8 Facing up stream at station 3+43 at blockage

Photo 9 Facing down stream at meander bank at station 4+38

Photo 10 Facing up stream at meander bank at station 4+38

Photo 11 Facing up stream of blockage at station 5+46

Photo 12 Facing down stream of blockage at station 5+46

Photo 13 Facing up stream at station 7+78 (cross section 2)

Photo 14 Facing left bank at cross section 2

Photo 15 Facing right bank at cross section 2

Photo 16 Facing down stream at cross section 2 looking at blockage at station 8+08

Photo 17 Facing up stream at station 12+23 (cross section 3)

Photo 18 Facing down stream at cross section 3

Photo 19 Facing right bank at cross section 3

Photo 20 Facing left bank at cross section 3

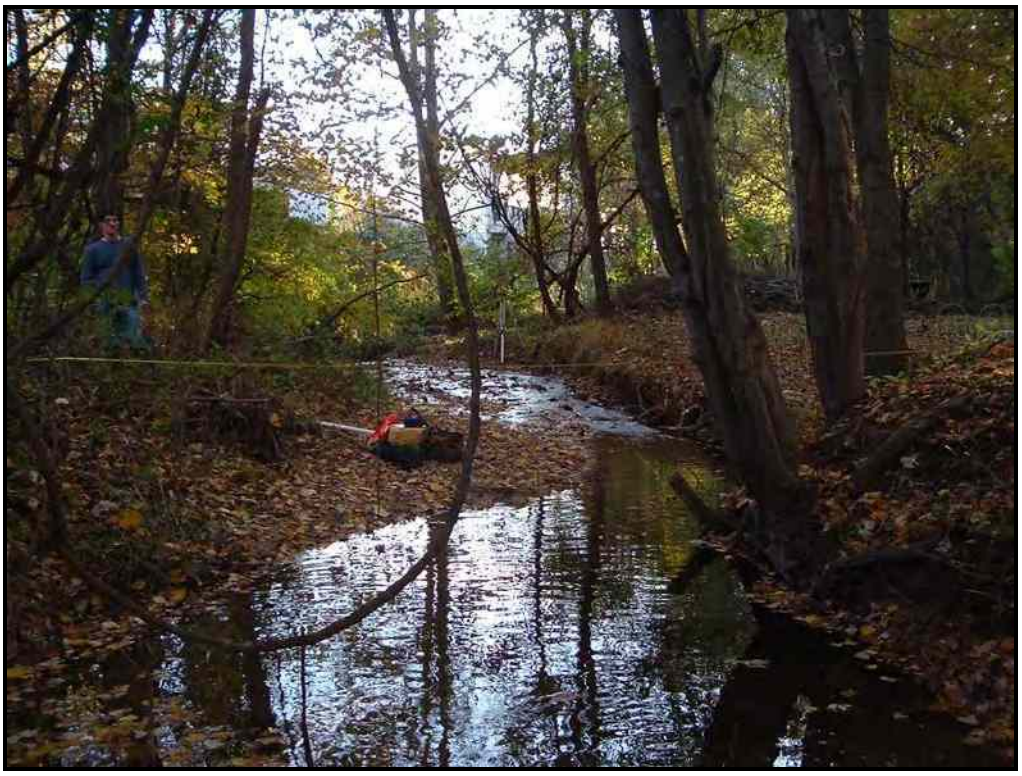


Photo 21 Facing up stream at station 12+70 (cross section 4)

Photo 22 Facing down stream at cross section 4

Photo 23 Facing right bank at cross section 4

Photo 24 Facing left bank at cross section 4

Photo 25 Facing up stream at culvert of Sunnyview Rd (station14+69)

Photo 26 Facing down stream at culvert of Sunnyview Rd (station14+69)

Photo 27 Facing up stream, down stream of culvert

Photo 28 Facing down stream, down stream of culvert

Photo 29 Facing left bank (facing down stream) at station 24+24 (cross section 5)

Photo 30 Facing down stream at cross section 5

Photo 31 Facing up stream at station 26+60 (cross section 6)

Photo 32 Facing left bank at cross section 6

Photo 33 Facing right bank at cross section 6

Photo 34 Facing down stream at installation of sediment traps

Photo 35 Facing down stream at removal of sediment traps

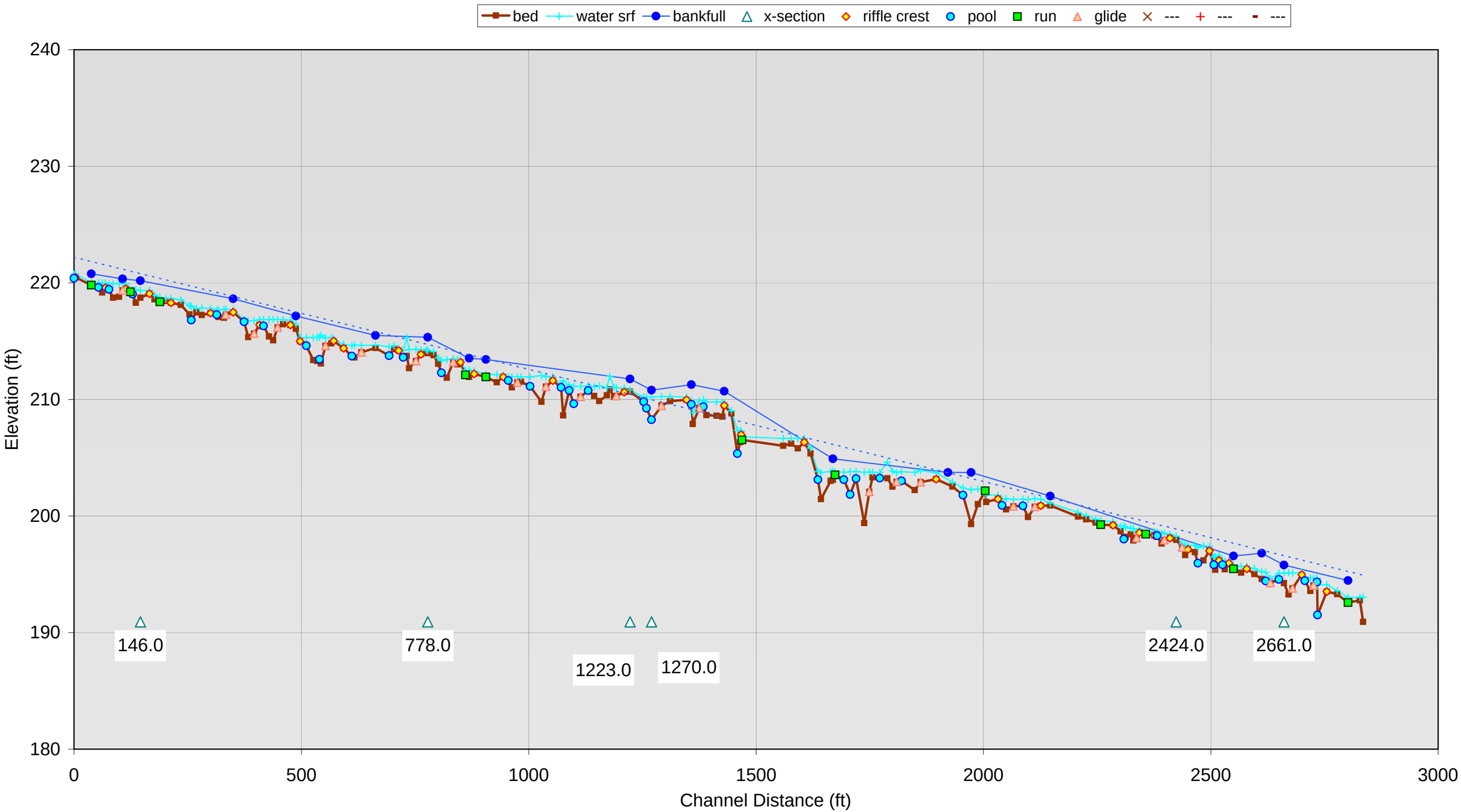
Photo 36 Facing down stream at depth gauge installation

Photo 37 Facing down stream at depth gauge removal

APPENDIX B

LONGITUDINAL PROFILE SURVEY DATA

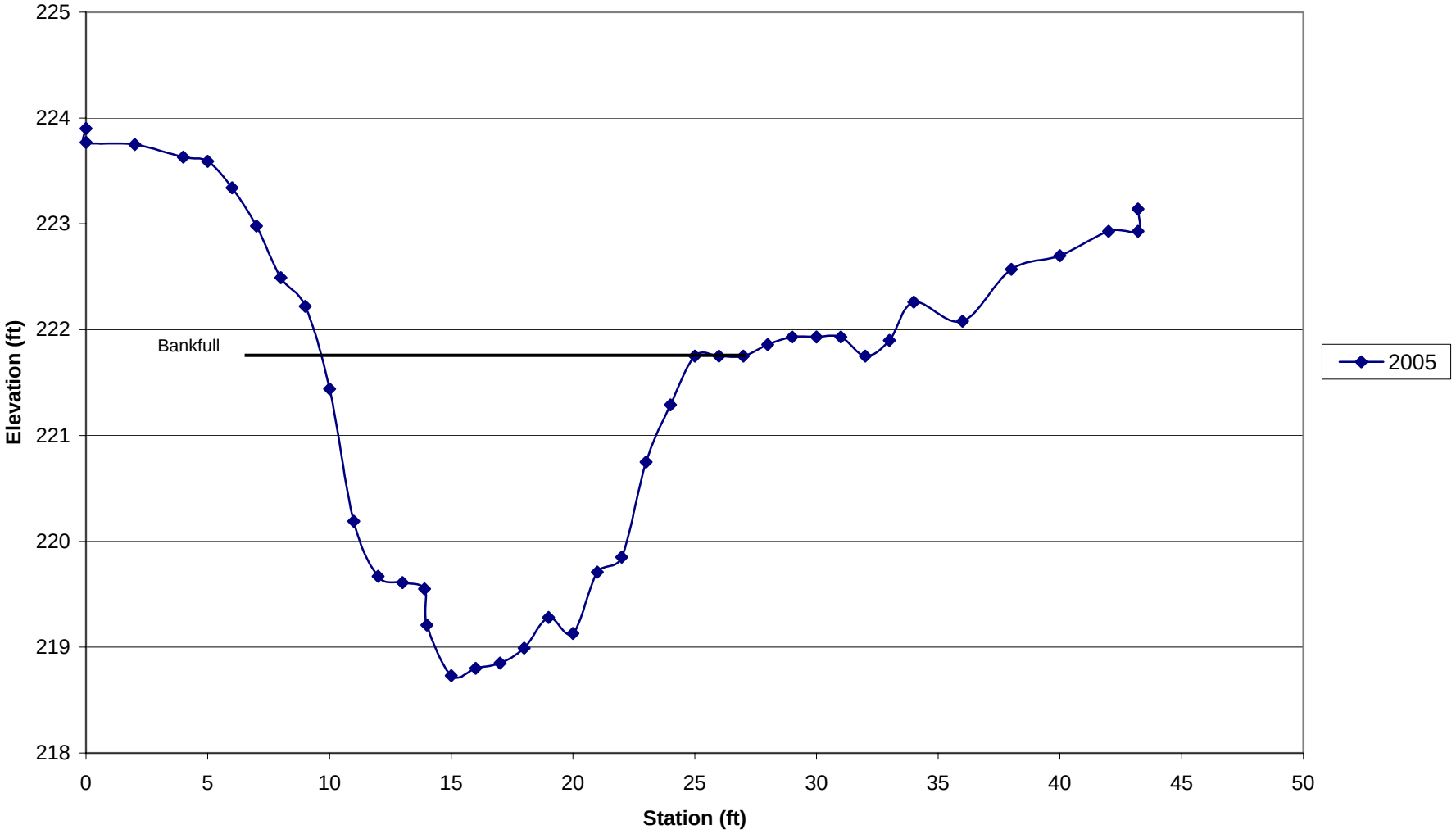
Unnamed Tributary to Bynum Run at Sunnyview



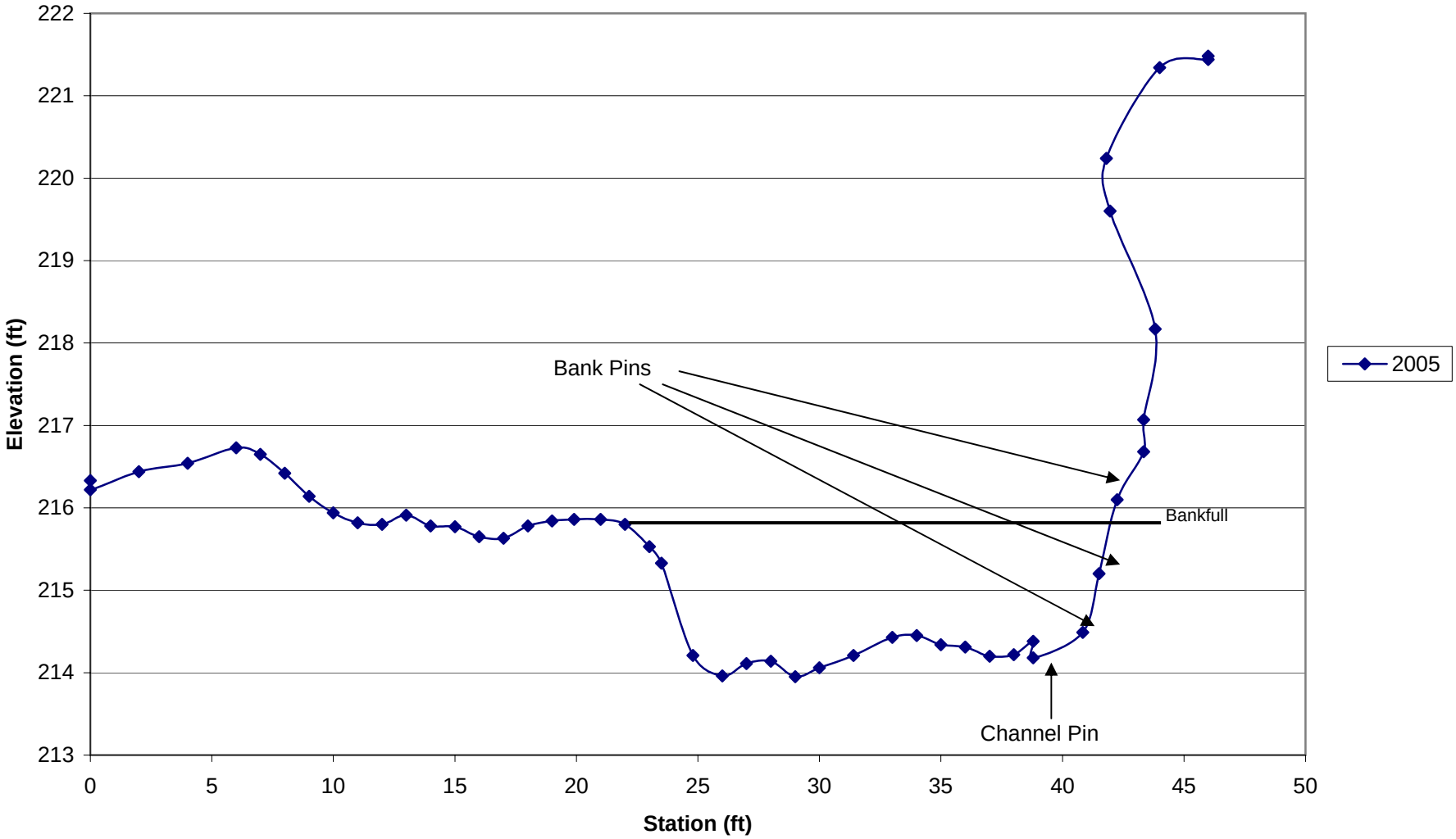
APPENDIX C

CROSS SECTIONAL SURVEY DATA

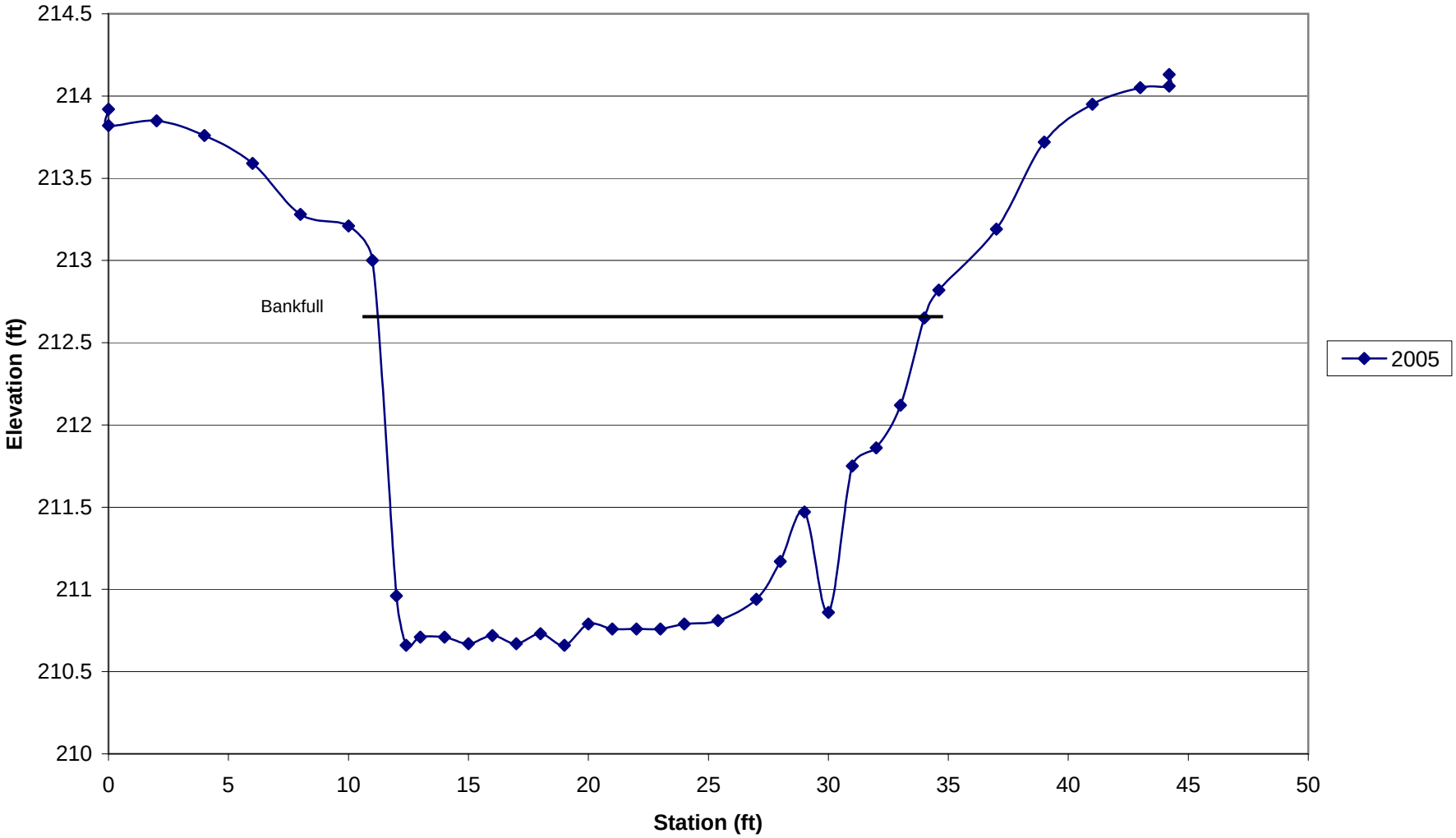
Sunnyview Physical Assessment
Cross Section 1
Station 1+46



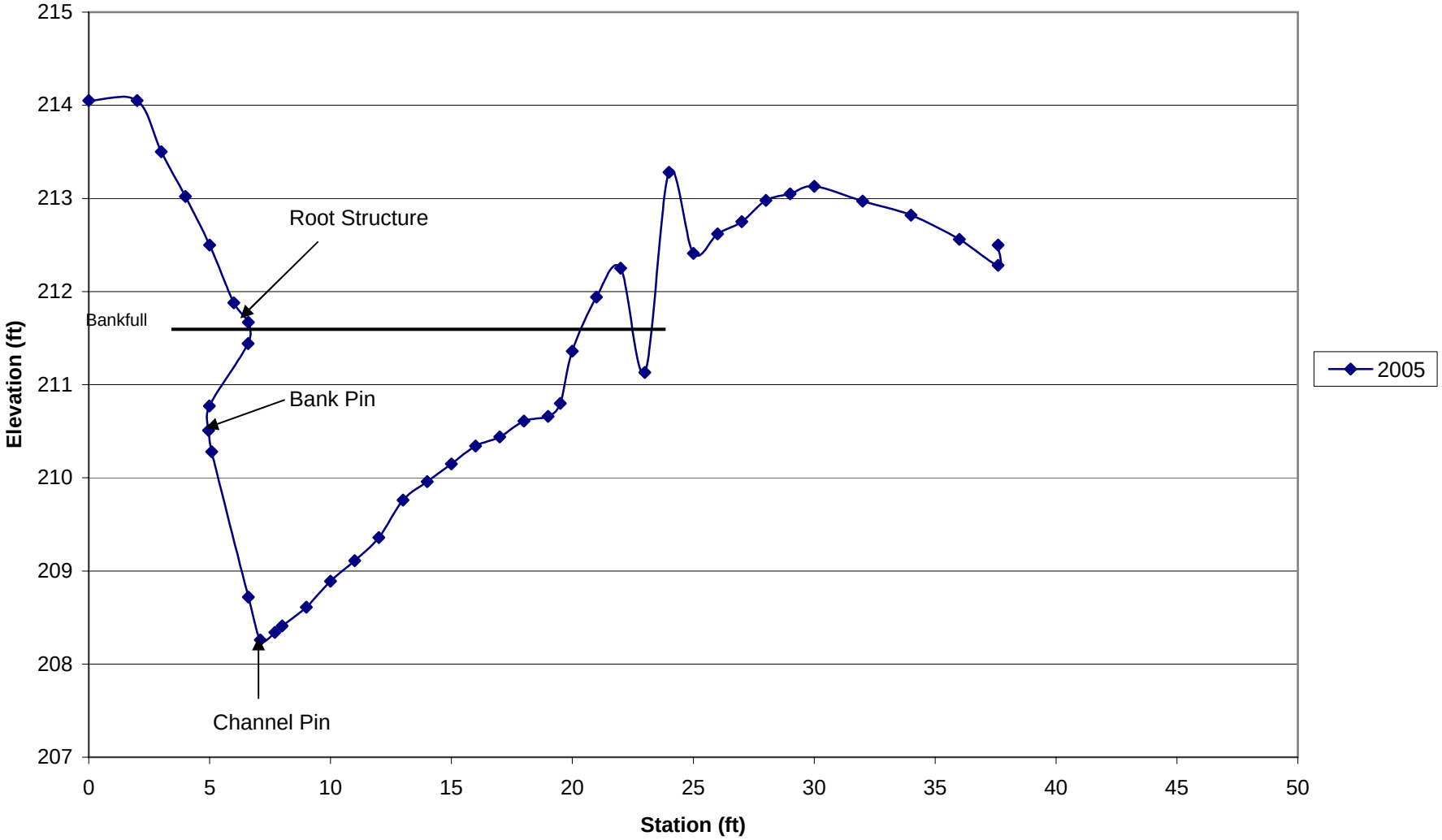
Sunnyview Physical Assessment
Cross Section 2
Station 7+78

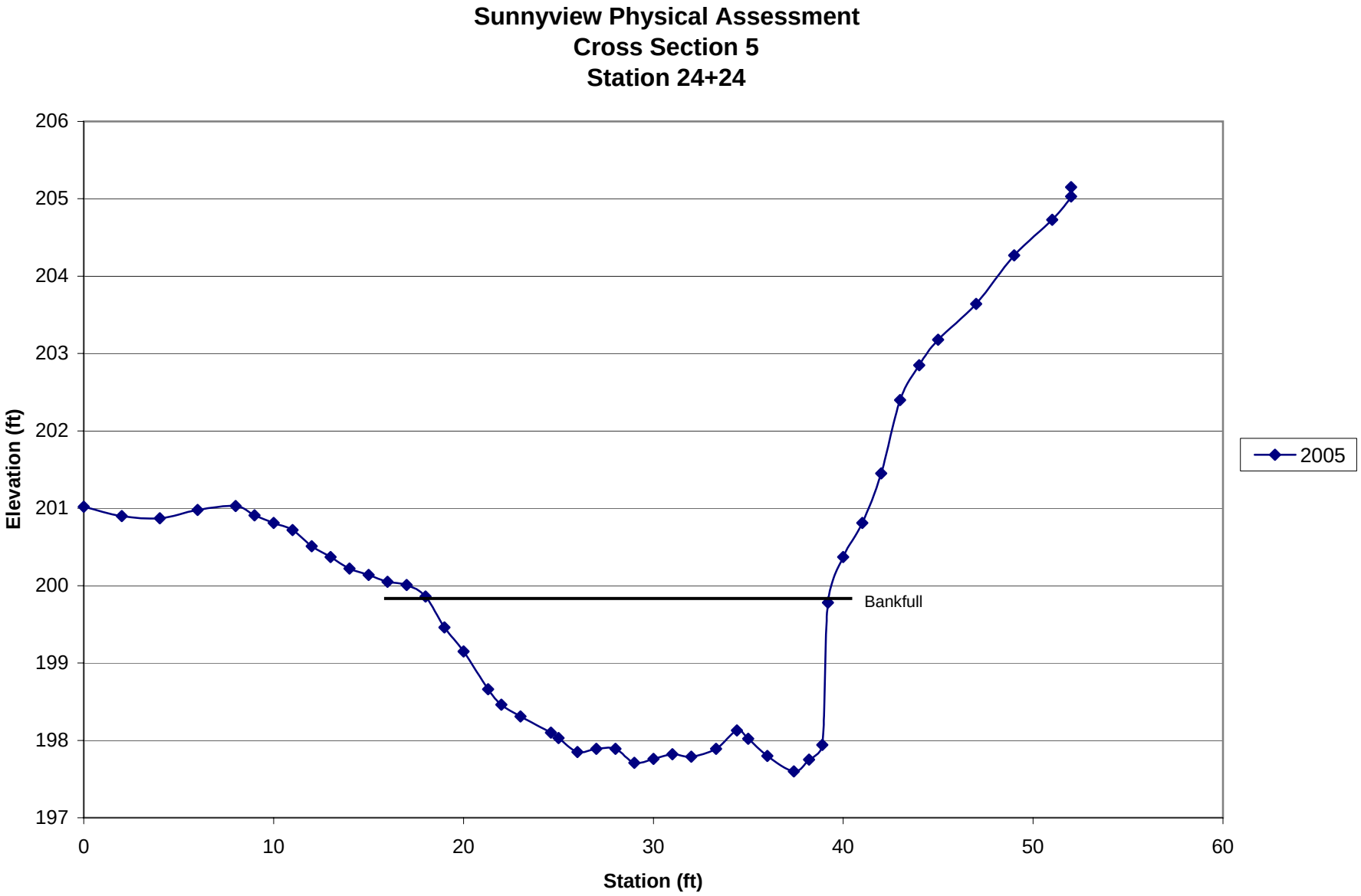


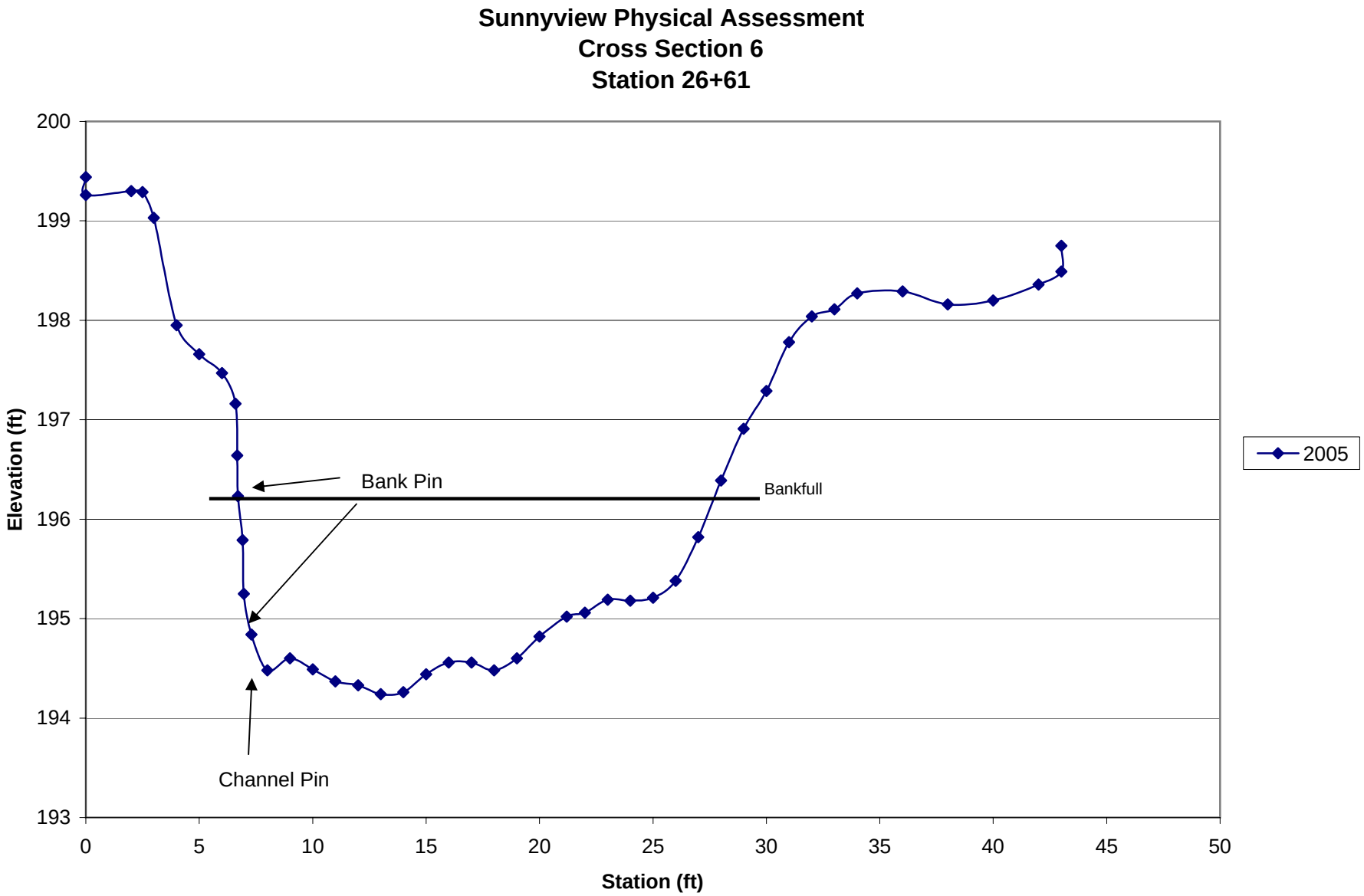
Sunnyview Physical Assessment
Cross Section 3
Station 12+23



Sunnyview Physical Assessment
Cross Section 4
Station 12+70



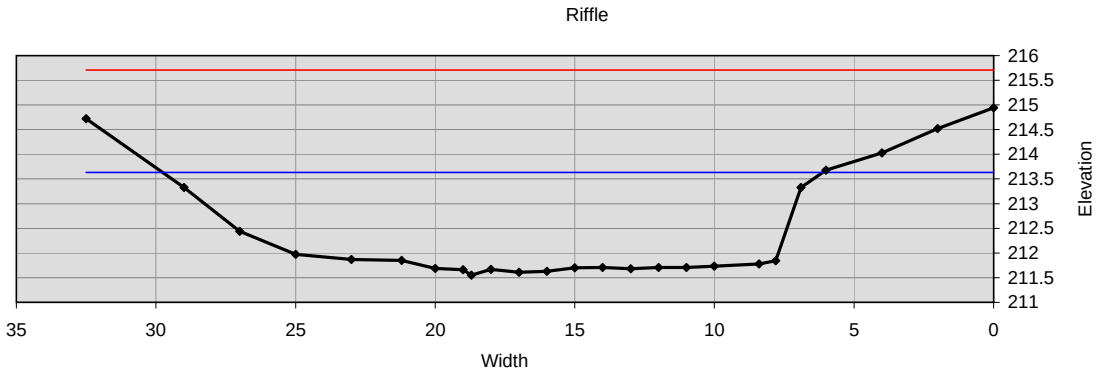

Sunnyview Physical Assessment
Cross Section 5
Station 24+24
206
205
204
203
202
201
200
199
198
197
Elevation (ft)
0
10
20
30
40
50
60
Station (ft)
Bankfull
2005


Sunnyview Physical Assessment
Cross Section 6
Station 26+61
200
199
198
197
196
195
194
193
Elevation (ft)
0
5
10
15
20
25
30
35
40
45
50
Station (ft)
Bank Pin
Bankfull
Channel Pin
2005

APPENDIX D

SEDIMENT AND DISCHARGE ANALYSIS

Cross Section 1



Bankfull Dimensions		Flood Dimensions		Materials	
38.0	x-section area (ft.sq.)	---	W flood prone area (ft)	---	D50 (mm)
23.6	width (ft)	---	entrenchment ratio	---	D84 (mm)
1.6	mean depth (ft)	---	low bank height (ft)	44	threshold grain size (mm):
2.1	max depth (ft)	---	low bank height ratio		
24.9	wetted parimeter (ft)				
1.5	hyd radi (ft)				
14.7	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
4.8	velocity (ft/s)	0.040	Manning's roughness	0.94	channel slope (%)
182.0	discharge rate (cfs)	0.16	D'Arcy-Weisbach fric.	0.90	shear stress (lb/sq.ft.)
0.68	Froude number	---	resistance factor u/u*	0.68	shear velocity (ft/s)
		---	relative roughness	4.5	unit strm power (lb/ft/s)

Cross Section

reference ID: 1
instrument height: 218.03 ---
longitudinal station: ---

Bankfull Stage

FS: 4.4 = 213.63 elev
elevation: ---

Low Bank Height

FS: ---
elevation:

Flood Prone Area

width fpa: 32.5

Channel Slope

percent slope: 0.94 ---

Flow Resistance

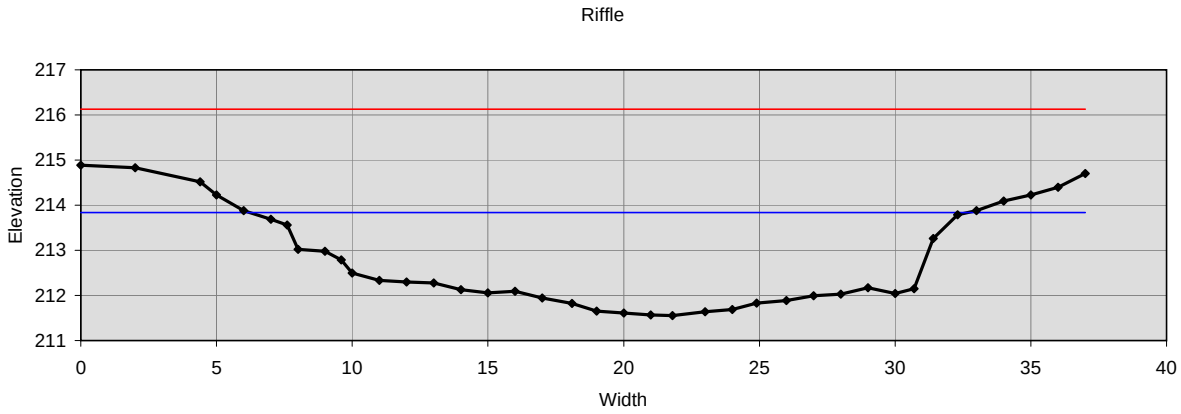
Manning's "n": 0.04 ---
D'Arcy - Weisbach "f": ---

Note:

Year 1 gage location at installation (facing DS): slope value retrieved from Sunny_Ref_Reach_4-1 L.xls, in Geomorph

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
0		218.03	3.09	214.94	☐	
2		218.03	3.51	214.52	☐	
4		218.03	4	214.03	☐	
6		218.03	4.35	213.68	☐	
6.9		218.03	4.7	213.33	☐	
7.8		218.03	6.19	211.84	☐	
8.4		218.03	6.25	211.78	☐	
10		218.03	6.3	211.73	☐	
11		218.03	6.32	211.71	☐	
12		218.03	6.32	211.71	☐	
13		218.03	6.35	211.68	☐	
14		218.03	6.32	211.71	☐	
15		218.03	6.33	211.7	☐	
16		218.03	6.4	211.63	☐	
17		218.03	6.42	211.61	☐	
18		218.03	6.36	211.67	☐	
18.7		218.03	6.48	211.55	☐	
19		218.03	6.37	211.66	☐	
20		218.03	6.34	211.69	☐	
21.2		218.03	6.18	211.85	☐	
23		218.03	6.16	211.87	☐	
25		218.03	6.06	211.97	☐	
27		218.03	5.59	212.44	☐	
29		218.03	4.7	213.33	☐	
32.5		218.03	3.31	214.72	☐	
					☐	
					☐	

Cross Section 2



Bankfull Dimensions		Flood Dimensions		Materials	
42.5	x-section area (ft.sq.)	---	W flood prone area (ft)	---	D50 (mm)
26.5	width (ft)	---	entrenchment ratio	---	D84 (mm)
1.6	mean depth (ft)	---	low bank height (ft)	44	threshold grain size (mm):
2.3	max depth (ft)	---	low bank height ratio		
27.8	wetted parimeter (ft)				
1.5	hyd radi (ft)				
16.5	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
4.8	velocity (ft/s)	0.040	Manning's roughness	0.94	channel slope (%)
204.0	discharge rate (cfs)	0.16	D'Arcy-Weisbach fric.	0.90	shear stress (lb/sq.ft.)
0.68	Froude number	---	resistance factor u/u*	0.68	shear velocity (ft/s)
		---	relative roughness	4.5	unit strm power (lb/ft/s)

Cross Section

reference ID	2	
instrument height	218.34	---
longitudinal station		---

Bankfull Stage

FS	4.5	= 213.84 elev
elevation		---

Low Bank Height

FS		---
elevation		

Flood Prone Area

width fpa		37.0

Channel Slope

percent slope	0.94	---

Flow Resistance

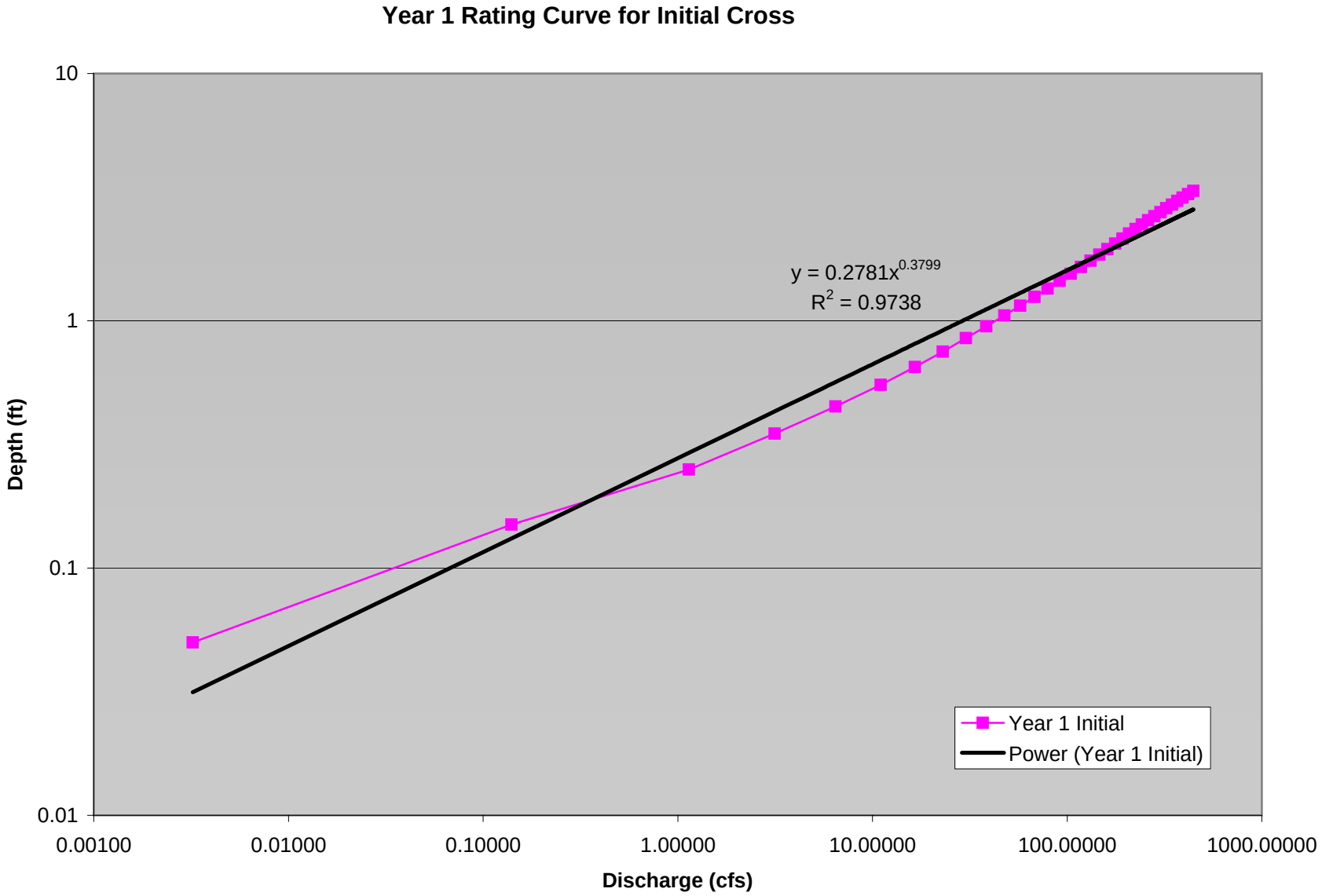
Manning's "n"	0.04	---
D'Arcy - Weisbach "f"		---

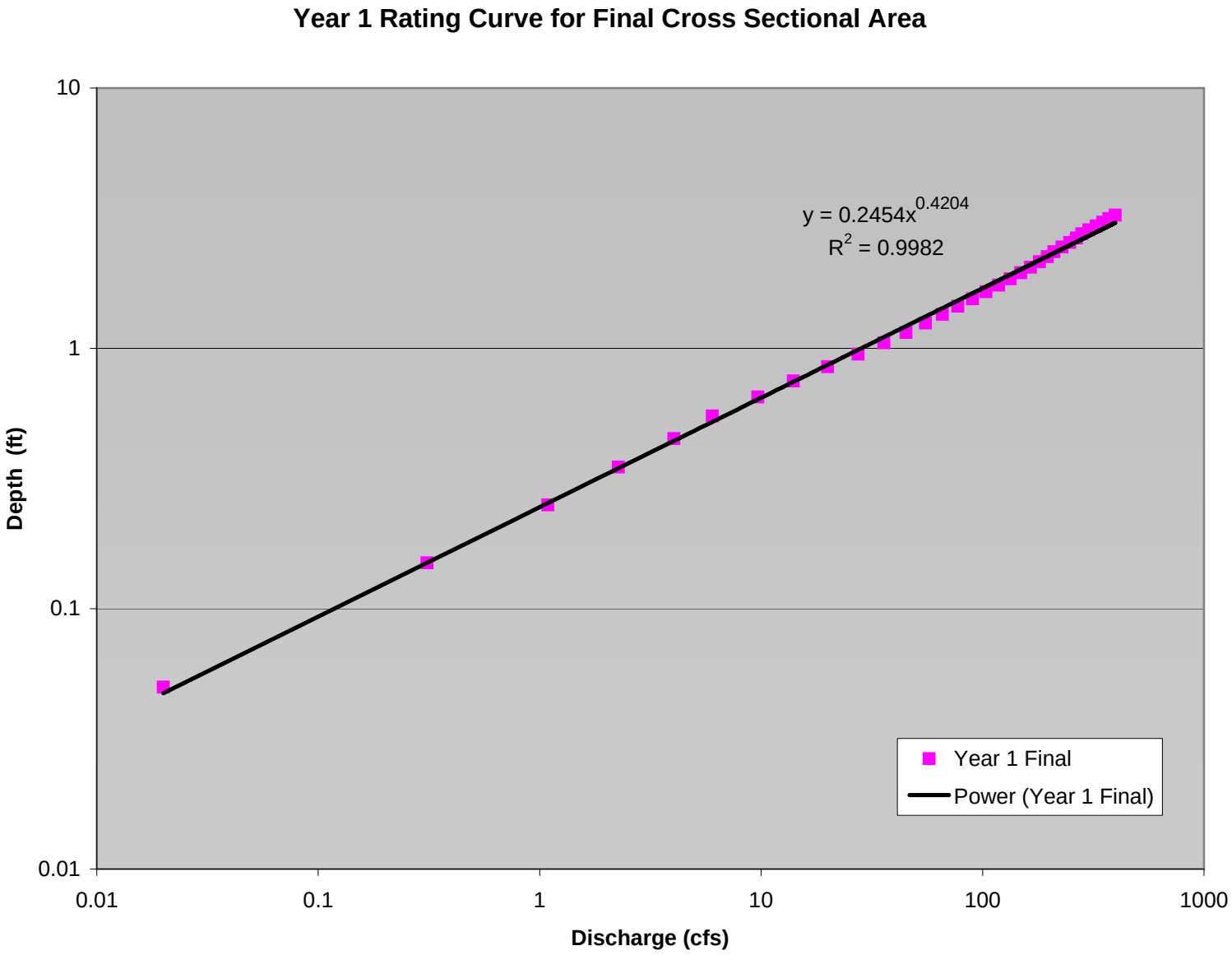
Note:

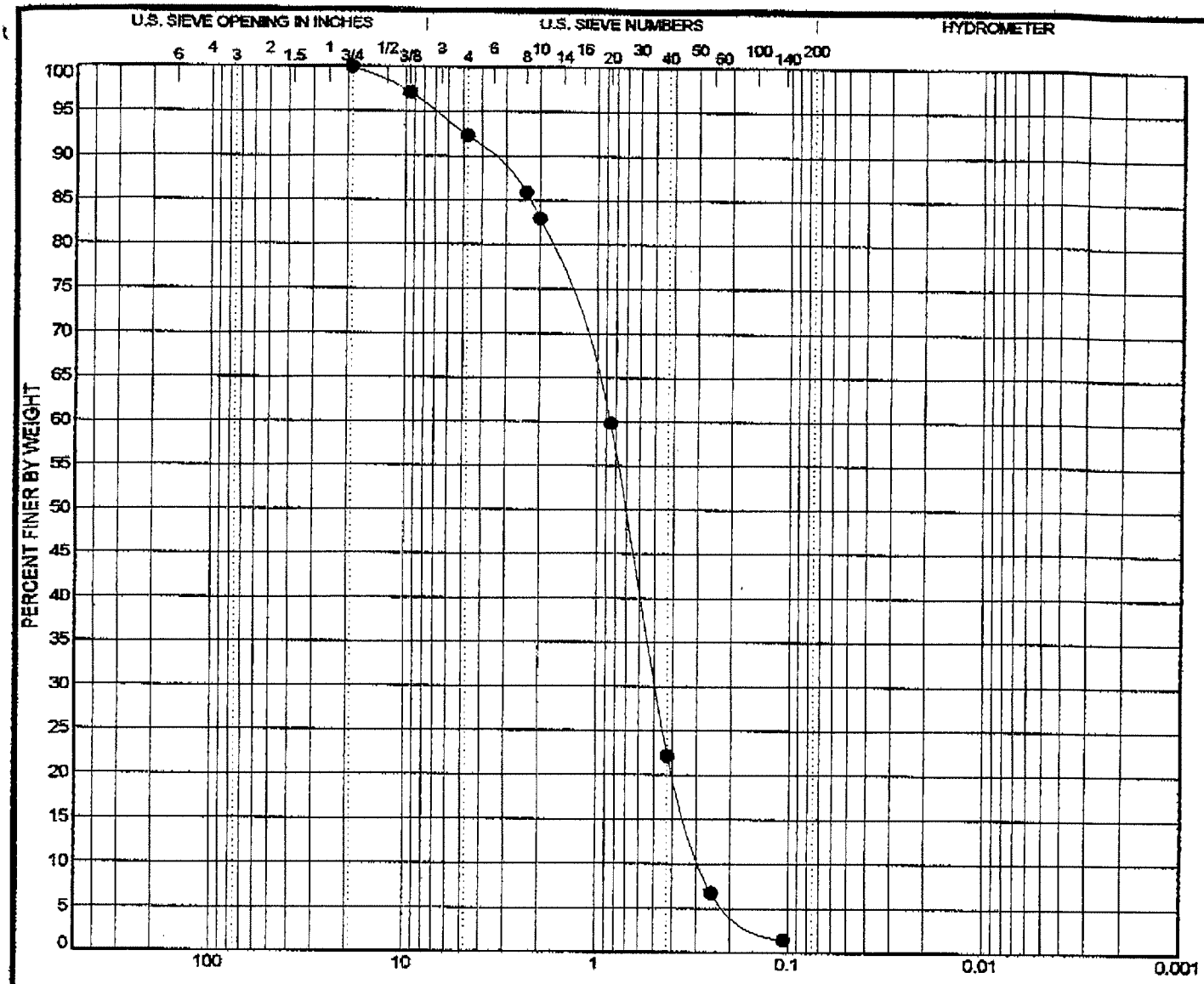
Resurvey(facing US) at end of yr 1, gauge was moved b/c it was thought that the cross section was being influenced by the

Distance (ft)	BS (ft)	HI (ft)	FS (ft)	Elevation (ft)	Omit Bkf	Notes
0		218.34	3.45	214.89	☐	
2		218.34	3.51	214.83	☐	
4.4		218.34	3.82	214.52	☐	
5		218.34	4.11	214.23	☐	
6		218.34	4.46	213.88	☐	
7		218.34	4.65	213.69	☐	
7.6		218.34	4.78	213.56	☐	
8		218.34	5.32	213.02	☐	
9		218.34	5.36	212.98	☐	
9.6		218.34	5.55	212.79	☐	
10		218.34	5.84	212.5	☐	
11		218.34	6.01	212.33	☐	
12		218.34	6.04	212.3	☐	
13		218.34	6.06	212.28	☐	
14		218.34	6.21	212.13	☐	
15		218.34	6.28	212.06	☐	
16		218.34	6.25	212.09	☐	
17		218.34	6.4	211.94	☐	
18.1		218.34	6.52	211.82	☐	
19		218.34	6.69	211.65	☐	
20		218.34	6.73	211.61	☐	
21		218.34	6.77	211.57	☐	
21.8		218.34	6.79	211.55	☐	
23		218.34	6.7	211.64	☐	
24		218.34	6.65	211.69	☐	
24.9		218.34	6.51	211.83	☐	
26		218.34	6.45	211.89	☐	

☐


Year 1 Rating Curve for Initial Cross
10
1
0.1
0.01
Depth (ft)
y = 0.2781x^0.3799
R^2 = 0.9738
Year 1 Initial
Power (Year 1 Initial)
0.00100
0.01000
0.10000
1.00000
10.00000
100.00000
1000.00000
Discharge (cfs)


Year 1 Rating Curve for Final Cross Sectional Area
y = 0.2454x^0.4204
R2 = 0.9982
Year 1 Final
Power (Year 1 Final)
Depth (ft)
Discharge (cfs)
10
1
0.1
0.01
0.01
0.1
1
10
100
1000



	% COBBLES	% GRAVEL		% SAND			% FINES	
		coarse	fine	coarse	medium	fine	SILT	CLAY
●		7.7						

	NMC	LL	PL	PI	D100	D60	D30	D10	Cc	Cu
●				NT	19	0.855	0.491	0.279	1.01	3.06

	Specimen Identification	MATERIAL DESCRIPTION	METHOD	USCS	AASHTO
●	042606	Largest Particle: 1.0" x 0.6" x 0.4"			
		4.1 grams			
	Small storm April 24-25, 2006				

KCI TECHNOLOGIES

GRAIN SIZE DISTRIBUTION

Project: Sunnyview
Client:
Location:
Date: 5/3/06

Figure No.

KCI Job No. 01031311-DE

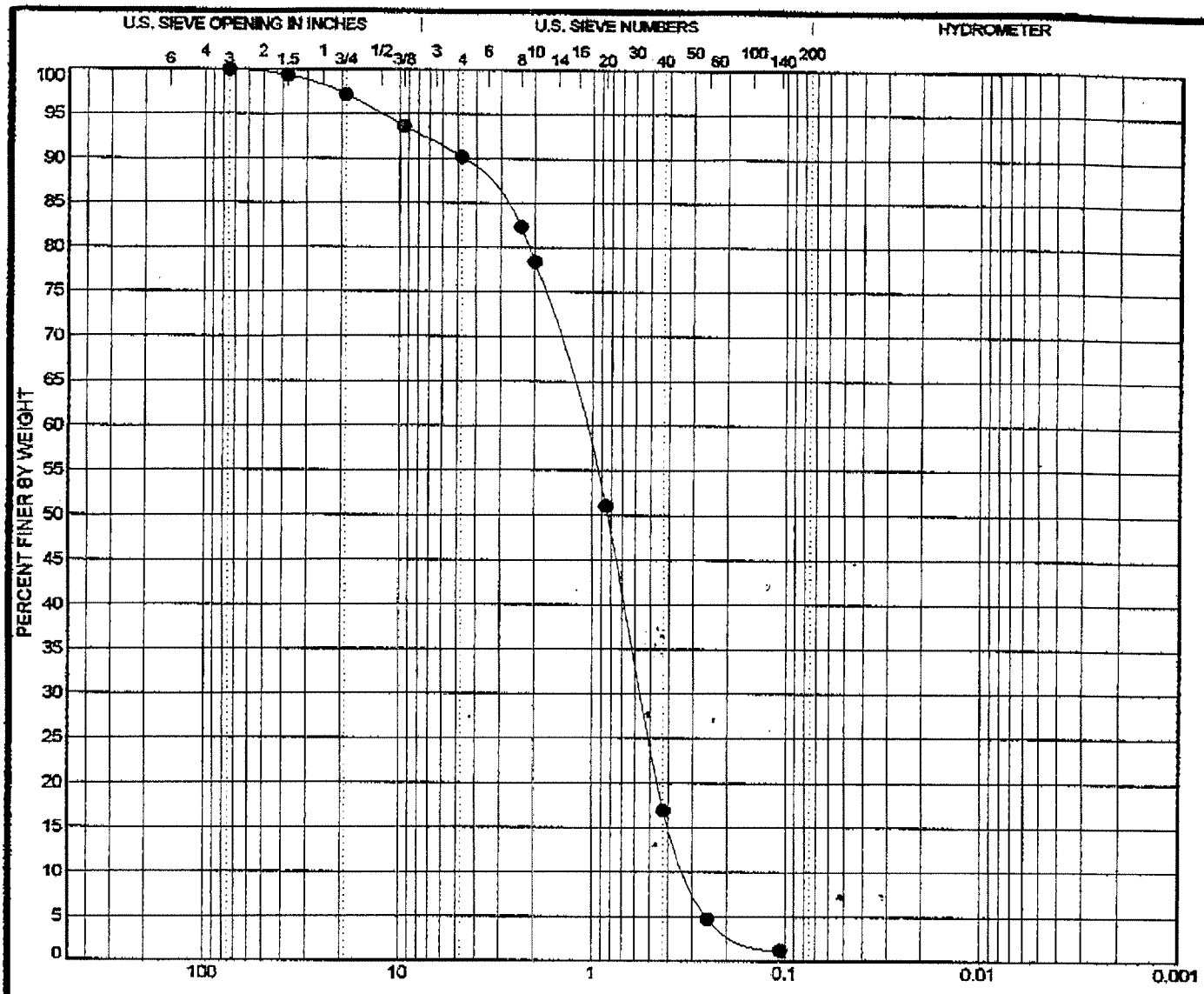
KCI SOIL CLASSIFICATION SUNNYVIEW.GPJ KCI.GDT 5/3/06

5/3/2006 8:38:33 AM
CG1007
KCI Technologies, Inc
Version 5.1.043

INPUT - c:\program files\gint\projects\kci projects\sunnyview.gpj: SIEVE table Library: c:\progra~1\gint\kci_lib.glb

PointID,Depth: 042606, 1

Sieve Size (mm)	~~Sieve~~ Tyler / U.S. size	Percent Finer
19	3/4"	100
9.5	3/8"	97.17605
4.75	#8	92.33146
2.36	#4	85.91114
2	#10	82.94507
0.85	#20	59.85293
0.425	#40	22.12816
0.25	#60	6.797256
0.106	#140	1.495396



	% COBBLES	% GRAVEL		% SAND			% FINES	
		coarse	fine	coarse	medium	fine	SILT	CLAY
●		9.8						

	NMC	LL	PL	PI	D100	D60	D30	D10	Cc	Cu
●				NT	75	1.126	0.555	0.314	0.87	3.58

	Specimen Identification	MATERIAL DESCRIPTION	METHOD	USCS	AASHTO
●	042406	Largest Particle: 4.4" x 2.1" x 1.1"			
		200.0 grams			
	Storm April 21-22, 2006				

KCI TECHNOLOGIES

GRAIN SIZE DISTRIBUTION

Project: Sunnyview
Client:
Location:
Date: 5/3/06

Figure No.

KCI Job No. 01031311-DE

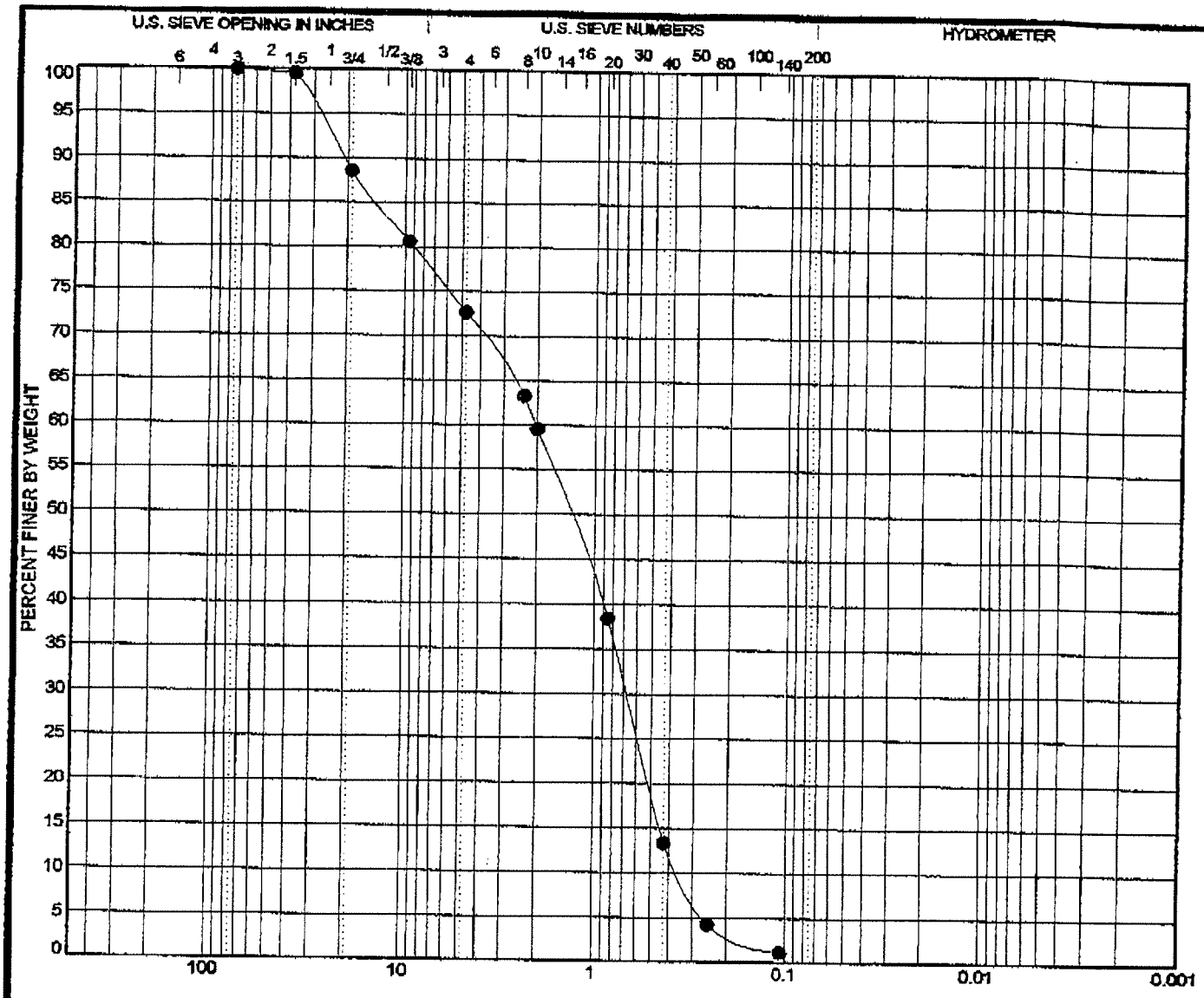
KCI SOIL CLASSIFICATION SUNNYVIEW.GPJ KCI.GDT 5/3/06

CG1007
KCI Technologies, Inc
Version 5.1.043

INPUT - c:\program files\gint\projects\kci projects\sunnyview.gpj: SIEVE table Library: c:\progra~1\gint\kci_lib.glb

PointID,Depth: 042406, 1

Sieve Size (mm)	~~ASTM~~ Tyler or US. SIZE	Percent Finer
75	3"	100
37.5	1 1/2"	99.41866
19	3/4"	97.22351
9.5	3/8"	93.69594
4.75	# 4	90.23231
2.36	# 8	82.34815
2	# 10	78.41479
0.85	# 20	51.00223
0.425	# 40	16.91238
0.25	# 60	4.768161
0.106	# 140	1.227793



	% COBBLES	% GRAVEL		% SAND			% FINES	
		coarse	fine	coarse	medium	fine	SILT	CLAY
●		27.4						

	NMC	LL	PL	PI	D100	D60	D30	D10	Cc	Cu
●				NT	75	2.041	0.673	0.35	0.63	5.83

	Specimen Identification	MATERIAL DESCRIPTION	METHOD	USCS	AASHTO
●	051506	largest particle: 3.4 x 2.6 x 2.3 inches			
		351.1 grams			
	Storm on May 11 2006				

KCI TECHNOLOGIES

GRAIN SIZE DISTRIBUTION

Project: Sunnyview
Client:
Location:
Date: 5/23/06

Figure No.

KCI Job No. 01031311-DE

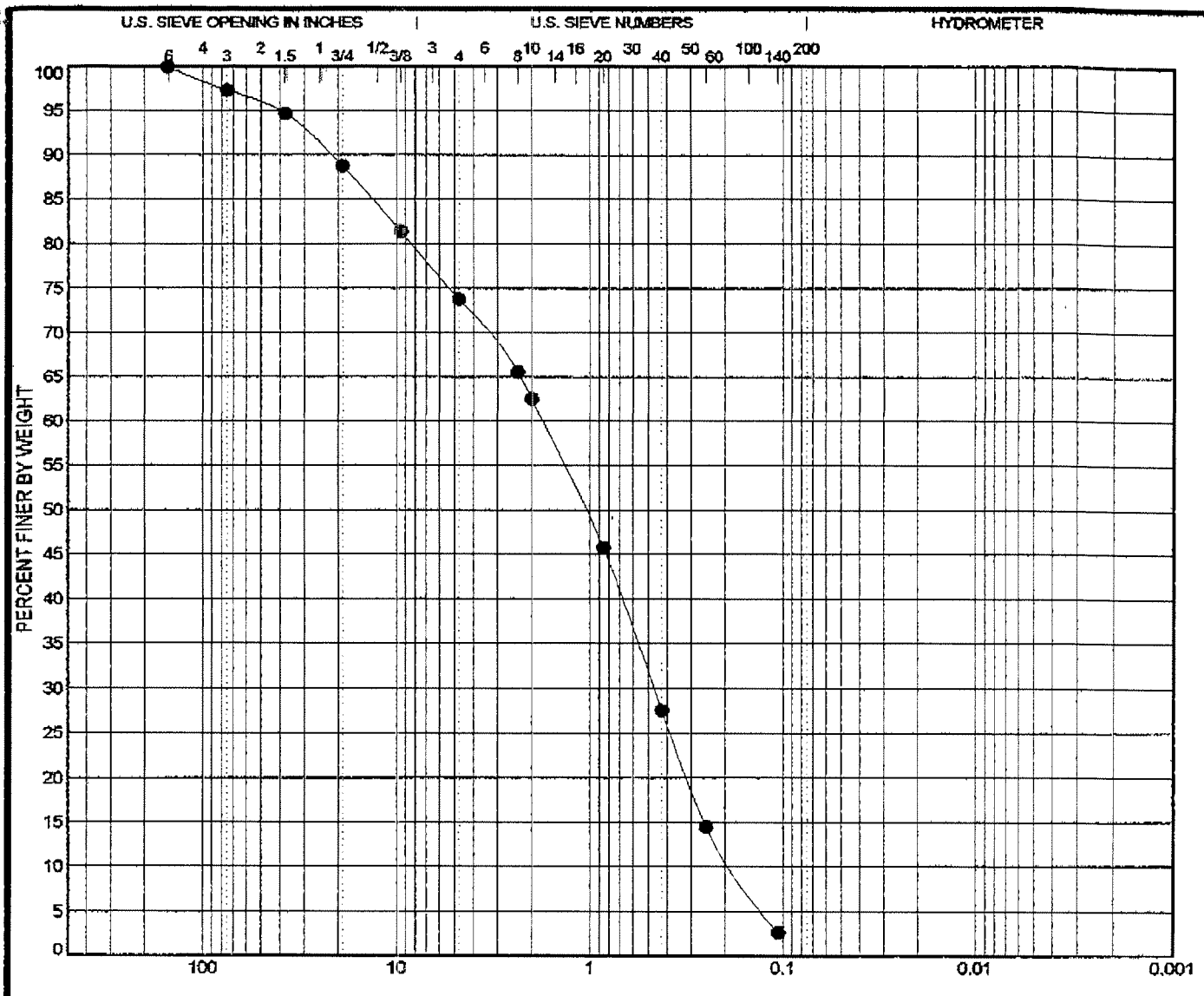
KCI SOIL CLASSIFICATION SUNNYVIEW.GPJ KCI1.GDT 5/23/06

KCI Technologies, Inc
Version 5.1.043

INPUT - c:\program files\gint\projects\kci projects\sunnyview.gpj: SIEVE table Library: c:\progra~1\gint\kci_lib.glb

PointID,Depth: 051506, 1

Sieve Size (mm)	[redacted] U.S. Size	Percent Finer
75	3"	100
37.5	1½"	99.57597
19	¾"	88.55112
9.5	⅜"	80.59519
4.75	# 4	72.63733
2.36	# 8	63.26602
2	# 10	59.5446
0.85	# 20	38.45141
0.425	# 40	13.30571
0.25	# 60	4.251941
0.106	# 140	1.150115



	% COBBLES	% GRAVEL		% SAND			% FINES	
		coarse	fine	coarse	medium	fine	SILT	CLAY
●		23.6						

	NMC	LL	PL	PI	D100	D60	D30	D10	Cc	Cu
●				NT	152.4	1.763	0.467	0.181	0.68	9.76

	Specimen Identification	MATERIAL DESCRIPTION	METHOD	USCS	AASHTO
●	06D806	Largest Particle: 3.4" x 3.4" x 3.3"			
		752.4 grams			
	Storm on June 3, 2006				

KCI TECHNOLOGIES

GRAIN SIZE DISTRIBUTION

Project: Sunnyview
Client:
Location:
Date: 6/20/06

Figure No.

KCI Job No. 01031311-DE

KCI SOIL CLASSIFICATION SUNNYVIEW.GPJ KCI1.GDT 6/20/06

C91007
KCI Technologies, Inc
Version 5.1.043

INPUT - c:\program files\gint\projects\kci projects\sunnyview.gpj: SIEVE table Library: c:\progra~1\gint\kci_lib.glb

PointID,Depth: 060806, 1

Sieve Size (mm)	U.S. Size	Percent Finer
152.4	6"	100
75	3"	97.3317
37.5	1½"	94.73432
19	¾"	88.74883
9.5	⅜"	81.38574
4.75	# 4	73.76381
2.36	# 8	65.52843
2	# 10	62.4754
0.85	# 20	45.7192
0.425	# 40	27.53754
0.25	# 60	14.47973
0.106	# 140	2.659433

APPENDIX E
MACROINVERTEBRATE DATA

Macroinvertebrate Data Report

ES&C ID: **1882-A**

Project: **05-KCI04-001**

Client Name	**KCI Technologies**	Station Number:	**SV-US**	Sample Date:	**11/4/05**
Description:	**Identification to Genus**	Location	**Upstream**	Check In Date:	**11/18/05**
Station Name:	**SV-US**	Sampler:		Sort Date:	**11/8/05**
Stream Name:	**Sunnyview**	Replicate:	**1**	ID Date:	**11/26/05**
Centroid Geo. Loc. (decimal degrees):	Latitude: **0**	Longitude:	**0**	Report Date:	**11/29/05**

Taxa Listing

ITIS TSN	*Scientific Name*	*LifeStage*	*FBI Tolerance*	*Functional Group*	*Count*
115408	**Cheumatopsyche**	I	6	FC	**12**
102139	**Argia**	I	9	PR	**1**
119037	**Tipula**	I	3	SH	**5**
102052	**Calopteryx**	I	5	PR	**3**
68440	**Lumbriculidae**	U	8	GC	**2**
103900	**Microvelia**	A	6	PR	**3**
101645	**Boyeria**	I		PR	**2**
127278	**Dasyhelea**	I	6	GC	**1**
115453	**Hydropsyche**	I	6	FC	**2**
109234	**Carabidae**	I		PR	**1**
115399	**Diplectrona**	I	6	FC	**2**
99237	**Collembola**	U		GC	**2**
115273	**Chimarra**	I	3	FC	**1**
68422	**Oligochaeta**	U		GC	**1**
114095	**Stenelmis**	A	4	SC	**1**
76483	**Lymnaeidae**	A	7	SC	**1**
115095	**Trichoptera**	P			**1**
113150	**Helochares**	I	5	OM	**2**
128874	**Orthocladius**	I	6	GC	**11**
129254	**Chironomus**	I	6	GC	**2**
128520	**Chaetocladius**	I	6	GC	**3**
128968	**Parakiefferiella**	I	6	GC	**2**

I= Immature, P=pupa, A=adult, U=undetermined Fraction of Total Sample Sub-sampled:

Macroinvertebrate Data Report

ES&C ID: **1883-A**

Project: **05-KCI04-001**

Client Name	**KCI Technologies**	Station Number:	**SV-REF**	Sample Date:	**11/4/05**
Description:	**Identification to Genus**	Location	**Reference Reach**	Check In Date:	**11/18/05**
Station Name:	**SV-REF**	Sampler:		Sort Date:	**11/8/05**
Stream Name:	**Sunnyview**	Replicate:	**1**	ID Date:	**11/22/05**
Centroid Geo. Loc. (decimal degrees):	Latitude: **0**	Longitude:	**0**	Report Date:	**11/29/05**

Taxa Listing

ITIS TSN	*Scientific Name*	*LifeStage*	*FBI Tolerance*	*Functional Group*	*Count*
114126	**Dubiraphia**	I	4	GC	**6**
115399	**Diplectrona**	I	6	FC	**5**
102052	**Calopteryx**	I	5	PR	**3**
102789	**Taeniopteryx**	I	2	SH	**14**
92686	**Caecidotea**	U	8	GC	**13**
114126	**Dubiraphia**	A	4	GC	**3**
102061	**Lestes**	I		PR	**1**
114095	**Stenelmis**	A	4	SC	**2**
119037	**Tipula**	I	3	SH	**1**
100507	**Stenonema**	I	4	SC	**3**
114667	**Anchytarsus**	I		SH	**6**
101095	**Leptophlebiidae**	I	2	GC	**9**
100504	**Heptageniidae**	I	4	SC	**3**
101324	**Eurylophella**	I	4	SC	**1**
100755	**Baetidae**	I	4	GC	**4**
101645	**Boyeria**	I		PR	**1**
103900	**Microvelia**	A	6	PR	**1**
115391	**Lype**	I	2	SC	**2**
57577	**Prostoma**	U			**2**
102643	**Capniidae**	I	1	SH	**12**
102139	**Argia**	I	9	PR	**1**
117043	**Polycentropodidae**	I	6	FC	**1**
68422	**Oligochaeta**	U		GC	**2**
76591	**Planorbidae**	U	7	SC	**1**
102914	**Perlidae**	I	1	PR	**2**
94025	**Hyalella**	U		GC	**1**
129535	**Microtendipes**	I	6	FC	**3**
129820	**Tribelos**	I	6	GC	**1**
128277	**Procladius**	I	6	PR	**1**
128978	**Parametriocnemus**	I	6	GC	**1**

Macroinvertebrate Data Report

ES&C ID: **1883-A**

Project: **05-KCI04-001**

Client Name	**KCI Technologies**	Station Number:	**SV-REF**	Sample Date:	**11/4/05**
Description:	**Identification to Genus**	Location	**Reference Reach**	Check In Date:	**11/18/05**
Station Name:	**SV-REF**	Sampler:		Sort Date:	**11/8/05**
Stream Name:	**Sunnyview**	Replicate:	**1**	ID Date:	**11/22/05**
Centroid Geo. Loc. (decimal degrees):	Latitude: **0**	Longitude:	**0**	Report Date:	**11/29/05**

94025	**Hyalella**	U		GC	**1**
111963	**Dytiscidae**	A	6	PR	**3**

I= Immature, P=pupa, A=adult, U=undetermined Fraction of Total Sample Sub-sampled:

Dytiscidae Ided as Neoporus (not in ITIS)

Macroinvertebrate Data Report

ES&C ID: **1884-A**

Project: **05-KCI04-001**

Client Name	**KCI Technologies**	Station Number:	**SV-RR**	Sample Date:	**11/4/05**
Description:	**Identification to Genus**	Location	**Reference Reach**	Check In Date:	**11/18/05**
Station Name:	**SV-RR**	Sampler:		Sort Date:	**11/8/05**
Stream Name:	**Sunnyview**	Replicate:	**1**	ID Date:	**11/23/05**
Centroid Geo. Loc. (decimal degrees):	Latitude: **0**	Longitude:	**0**	Report Date:	**11/29/05**

Taxa Listing

ITIS TSN	*Scientific Name*	*LifeStage*	*FBI Tolerance*	*Functional Group*	*Count*
119037	**Tipula**	I	3	SH	**7**
114095	**Stenelmis**	I	4	SC	**3**
115273	**Chimarra**	I	3	FC	**6**
115408	**Cheumatopsyche**	I	6	FC	**8**
103900	**Microvelia**	A	6	PR	**1**
102139	**Argia**	I	9	PR	**10**
102052	**Calopteryx**	I	5	PR	**9**
114126	**Dubiraphia**	I	4	GC	**2**
115319	**Dolophilodes**	I	3	GC	**1**
114095	**Stenelmis**	A	4	SC	**1**
114244	**Oulimnius**	I	4	SC	**3**
115570	**Ceratopsyche**	I	6	FC	**4**
101645	**Boyeria**	I		PR	**2**
76677	**Physa**	U	8	SC	**2**
68422	**Oligochaeta**	U		GC	**3**
114006	**Helichus**	A	5	SH	**2**
102643	**Capniidae**	I	1	SH	**2**
57577	**Prostoma**	U			**1**
113196	**Hydrobius**	I	5	PR	**3**
101603	**Aeshna**	I			**1**
128236	**Thienemannimyia**	I	6	PR	**1**
129428	**Dicrotendipes**	I	6	GC	**1**
128874	**Orthocladius**	I	6	GC	**1**
129978	**Tanytarsus**	I	6	FC	**1**
111963	**Dytiscidae**	A	6	PR	**2**

I= Immature, P=pupa, A=adult, U=undetermined Fraction of Total Sample Sub-sampled:

Dytiscidae Ided as Neoporus (not in ITIS), Referenced Aeshna

Unnamed Tributary to Bynum Run at Sunnyview Road
Benthic Macroinvertebrate Data

Harford County
2005

SV- US pre

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Odonata	Coenagrionidae	Argia	Argia		1	Predator	cn, cb, sp	9.3
Insecta	Odonata	Aeshnidae	Boyeria	Boyeria		2	Predator	cb, sp	6.3
Insecta	Odonata	Calopterygidae	Calopteryx	Calopteryx		3	Predator	cb	8.3
Insecta	Coleoptera	Carabidae	not identified	Carabidae		1	Predator	cn	na
Insecta	Diptera	Chironomidae	Chaetocladius	Chaetocladius		3	Collector	sp	7
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche		12	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra		1	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	Chironomus	Chironomus		2	Collector	bu	4.6
Hexapoda	Collembola	not identified	not identified	Collembola		2	Collector	sp, sk	6
Insecta	Diptera	Ceratopogonidae	Dasyhelea	Dasyhelea		1	Collector	sp	3.6
Insecta	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona		2	Filterer	cn	2.7
Insecta	Coleoptera	Hydrophilidae	Helochares	Helochares		2	Collector	na	na
Insecta	Trichoptera	Hydropsychidae	Hydropsyche	Hydropsyche		2	Filterer	cn	7.5
Clitellata	Lumbriculada	Lumbriculidae	not identified	Lumbriculidae		2	Collector	bu	6.6
Gastropoda	Basommatophora	Lymnaeidae	not identified	Lymnaeidae		1	Scraper	cb	6.9
Insecta	Hemiptera	Veliidae	Microvelia	Microvelia		3	Predator	skater	6
Clitellata	not identified	not identified	not identified	Oligochaeta		1	Collector	bu	10
Insecta	Diptera	Chironomidae	Orthocladius	Orthocladius		11	Collector	sp, bu	9.2
Insecta	Diptera	Chironomidae	Parakiefferiella	Parakiefferiella		2	Collector	sp	2.1
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis		1	Scraper	cn	7.1
Insecta	Diptera	Tipulidae	Tipula	Tipula		5	Shredder	bu	6.7
Insecta	Trichoptera	not identified	not identified	Trichoptera		1	na	na	4.6

1 Life Stage, I - Immature, P- Pupa, A - Adult; 2 Functional Feeding Group; 3 Habit or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler; 4 Tolerance Values, based on Hilsenhoff, modified for Maryland; na indicates information for the particular taxa was not available.

Unnamed Tributary to Bynum Run at Sunnyview Road
Benthic Macroinvertebrate Data

Harford County
2005

SV- Rest pre

Subphylum/Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Odonata	Aeshnidae	Aeshna	Aeshna		1	Predator	cb	3
Insecta	Odonata	Coenagrionidae	Argia	Argia		10	Predator	cn, cb, sp	9.3
Insecta	Odonata	Aeshnidae	Boyeria	Boyeria		2	Predator	cb, sp	6.3
Insecta	Odonata	Calopterygidae	Calopteryx	Calopteryx		9	Predator	cb	8.3
Insecta	Plecoptera	Capniidae	not identified	Capniidae		2	Shredder	sp, cn	3.7
Insecta	Trichoptera	Hydropsychidae	Ceratopsyche	Ceratopsyche		4	Filterer	cn	5
Insecta	Trichoptera	Hydropsychidae	Cheumatopsyche	Cheumatopsyche		8	Filterer	cn	6.5
Insecta	Trichoptera	Philopotamidae	Chimarra	Chimarra		6	Filterer	cn	4.4
Insecta	Diptera	Chironomidae	Dicrotendipes	Dicrotendipes		1	Collector	bu	9
Insecta	Trichoptera	Philopotamidae	Dolophilodes	Dolophilodes		1	Collector	cn	1.7
Insecta	Coleoptera	Elmidae	Dubiraphia	Dubiraphia		2	Scraper	cn, cb	5.7
Insecta	Coleoptera	Dytiscidae	not identified	Dytiscidae		2	Predator	sw, dv	5.4
Insecta	Coleoptera	Dryopidae	Helichus	Helichus		2	Scraper	cn	6.4
Insecta	Coleoptera	Hydrophilidae	Hydrobius	Hydrobius		3	Collector	cb, cn, sp	4.1
Insecta	Hemiptera	Veliidae	Microvelia	Microvelia		1	Predator	skater	6
Clitellata	not identified	not identified	not identified	Oligochaeta		3	Collector	bu	10
Insecta	Diptera	Chironomidae	Orthocladius	Orthocladius		1	Collector	sp, bu	9.2
Insecta	Coleoptera	Dryopidae	Oulimnius	Oulimnius		3	Scraper	cn	2.7
Gastropoda	Basommatophora	Physidae	Physa	Physa		2	Scraper	cb	7
Enopla	Hoplonemertea	Tetrastemmatidae	Prostoma	Prostoma		1	Predator	na	7.3
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	I	3	Scraper	cn	7.1
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis	A	1	Scraper	cn	7.1
Insecta	Diptera	Chironomidae	Tanytarsus	Tanytarsus		1	Filterer	cb, cn	4.9
Insecta	Diptera	Chironomidae	Thienemanniella	Thienemanniella		1	Collector	sp	5.1
Insecta	Diptera	Tipulidae	Tipula	Tipula		7	Shredder	bu	6.7

1 Life Stage, I - Immature, P- Pupa, A - Adult; 2 Functional Feeding Group; 3 Habitat or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler; 4 Tolerance Values, based on Hilsenhoff, modified for Maryland; na

Unnamed Tributary to Bynum Run at Sunnyview Road
Benthic Macroinvertebrate Data

Harford County
2005

SV- REF pre

Subphylum/ Class	Order	Family	Genus	Final ID	Note[1]	# of Org	FFG[2]	Habit[3]	Tolerance Value[4]
Insecta	Coleoptera	Ptilodactylidae	Anchytarsus	Anchytarsus		6	Shredder	cn	3.1
Insecta	Odonata	Coenagrionidae	Argia	Argia		1	Predator	cn, cb, sp	9.3
Insecta	Ephemeroptera	Baetidae	not identified	Baetidae		4	Collector	sw, cn	2.3
Insecta	Odonata	Aeshnidae	Boyeria	Boyeria		1	Predator	cb, sp	6.3
Crustacea	Isopoda	Asellidae	Caecidotea	Caecidotea		13	Collector	sp	2.6
Insecta	Odonata	Calopterygidae	Calopteryx	Calopteryx		3	Predator	cb	8.3
Insecta	Plecoptera	Capniidae	not identified	Capniidae		12	Shredder	sp, cn	3.7
Insecta	Trichoptera	Hydropsychidae	Diplectrona	Diplectrona		5	Filterer	cn	2.7
Insecta	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	I	6	Scraper	cn, cb	5.7
Insecta	Coleoptera	Elmidae	Dubiraphia	Dubiraphia	A	3	Scraper	cn, cb	5.7
Insecta	Coleoptera	Dytiscidae	not identified	Dytiscidae		3	Predator	sw, dv	5.4
Insecta	Ephemeroptera	Ephemerellidae	Eurylophella	Eurylophella		1	Scraper	cn, sp	4.5
Insecta	Ephemeroptera	Heptageniidae	not identified	Heptageniidae		3	Scraper	cn	2.6
Crustacea	Amphipoda	Hyalellidae	Hyalella	Hyalella	U	1	Shredder	sp	4.2
Crustacea	Amphipoda	Hyalellidae	Hyalella	Hyalella	U	1	Shredder	sp	4.2
Insecta	Ephemeroptera	Leptophlebiidae	not identified	Leptophlebiidae		9	Collector	sw, cn	1.7
Insecta	Odonata	Lestidae	Lestes	Lestes		1	Predator	cb	9
Insecta	Trichoptera	Psychomyiidae	Lype	Lype		2	Scraper	cn	4.7
Insecta	Diptera	Chironomidae	Microtendipes	Microtendipes		3	Filterer	cn	4.9
Insecta	Hemiptera	Veliidae	Microvelia	Microvelia		1	Predator	skater	6
Clitellata	not identified	not identified	not identified	Oligochaeta		2	Collector	bu	10
Insecta	Diptera	Chironomidae	Parametriocnemus	Parametriocnemus		1	Collector	sp	4.6
Insecta	Plecoptera	Perlidae	not identified	Perlidae		2	Predator	cn	2.2
Gastropoda	Basommatophora	Planorbidae	not identified	Planorbidae		1	Scraper	cb	7.6
Insecta	Trichoptera	Polycentropodidae	not identified	Polycentropodidae		1	Filterer	cn	0.2
Insecta	Diptera	Chironomidae	Procladius	Procladius		1	Predator	sp	1.2
Enopla	Hoplonemertea	Tetrastemmatidae	Prostoma	Prostoma		2	Predator	na	7.3
Insecta	Coleoptera	Elmidae	Stenelmis	Stenelmis		2	Scraper	cn	7.1
Insecta	Ephemeroptera	Heptageniidae	Stenonema	Stenonema		3	Scraper	cn	4.6
Insecta	Plecoptera	Taeniopterygidae	Taeniopteryx	Taeniopteryx		14	Shredder	sp, cn	4.8
Insecta	Diptera	Tipulidae	Tipula	Tipula		1	Shredder	bu	6.7
Insecta	Diptera	Chironomidae	Tribelos	Tribelos		1	Collector	bu	7

1 Life Stage, I - Immature, P- Pupa, A - Adult; 2 Functional Feeding Group; 3 Habitat or form of locomotion, includes bu - burrower, cn - clinger, cb - climber, sk - skater, sp - sprawler;
4 Tolerance Values, based on Hilsenhoff, modified for Maryland; na

Sunnyview Sampling 11/4/05

Benthics Sampling - Grid Subsampling Tally Sheet

Reference Reach		Upstream		Restoration Reach 1 of 2		Restoration Reach 2 of 2			
grid	number	grid	number	grid	number	grid	number	grid	number
61	5	49	7	24	10	34	4		
75	7	29	2	71	7	6	4		
1	23	31	2	8	11	28	2		
74	6	63	10	73	1	70	11		
46	7	56	2	68	1	57	3		
4	10	7	4	13	3	75	2		
53	9	13	1	39	0	23	0		
7	7	41	1	29	3	20	3		
16	5	62	12	6	5	51	8		
31	16	51	3	35	5	46	4		
29	1	54	2	60	5	37	4		
42	9	10	1	52	4	24	4		
58	3	62	1	67	2	39	5		
49	17	26	4	3	1	32	3		
22	7	53	0	43	2	60	0		
		41	1			40	2		
		15	1			71	1		
		58	1			59	2		
		1	5						
		65	2						
		32	1						
		39	5						
		22	6						
		17	10						
		33	2						
		64	1						
		19	1						
		6	0						
		59	0						
		3	2						
		29	4						
		35	2						
		5	1						
		43	3						
		4	4						
		16	2						
		49	1						
		40	1						
		55	3						
		47	2						
		18	3						
		13	3						
		37	2						
15	***132***	***43***	***121***	***15***	***60***	***18***	***62***	***0***	***0***